



Technical Note 2

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Originated by:	AJ
Client:	Towerhouse Systems
Content:	Response to LLFA

1 Overview

This technical note has been prepared to in response to Manchester City Council's LLFA as per email received by Jonny Yusuf (DYSE) and Julian Austin (Paul Butler Associates) on Thursday 22/10/2020.

2 MCC comments

MCC commented as below:

1. Pursuant to Manchester's Core Strategy, Manchester City Council recognises the importance of green infrastructure and preservation of green spaces, and as such is required to build at least 90% of new houses on brownfield sites. When an applicant chooses to select greenfield land for their development application, they are expected to maximise retention of the greenfield characteristics through green infrastructure. This is stipulated in Policy EN 9 and is also stated in the Appeal Decision. While the Appeal Decision recognises the commitment to preserving green infrastructure pursuant to EN 9 with respect to the nearby Country Park, this does not negate the importance of applying EN 9 to the proposed site itself.
2. Infiltration testing is required on site as per the industry-standard Drainage Hierarchy. The applicant was also advised of this in the email response and attached developers' guidance issued by the LLFA on 28/08/2020. Conclusions cannot be drawn from

desktop study or preliminary intrusive investigations without specific investigation into permeable strata at various depths and testing to BRE 365 standard. Infiltration as a discharge mechanism would best mimic the current drainage regime of the greenfield site and as such it will need to be extensively investigated before we are satisfied that the development's drainage mechanism can progress through the Hierarchy.

3. With regards to investigation into discharge to a proximal watercourse as per the hierarchy, we would typically advise the applicant to initiate discussions with the 3rd party land owner to make such a connection. However, in this case we are satisfied that, as a last resort, discharge into the surface water sewer would be acceptable on the premise that you present us with confirmation that it drains to the Black Brook.
4. Volume control is required as per the government-issued Non-Statutory Technical Guidance for SuDS and as advised in the developers' pack issued 22/08/2020. In the event that discharge is via the surface water sewer into the Black Brook, volume control will be required as per the national guidance and developer's pack. Prolonged peak flows during storm events can damage watercourse geomorphology and increase flood risk to 3rd party properties along the watercourse. It is not acceptable for the development of this greenfield site to omit volume control.
5. The applicant was made aware of the need to consider green SuDS by the email response and the attached developers' guidance issued by the LLFA on 28/08/2020. As the applicant has selected a greenfield site to develop, green SuDS solutions would best mimic the current natural drainage components of the greenfield site. The possibility of implementing green SuDS is unlikely to be restricted by the presence of contaminated land often found on brownfield sites in Manchester. Green SuDS components offer mechanisms to achieve volume reduction in line with the required volume control through bioretention and infiltration. Engineered soils can also be implemented to enhance infiltration in bioretentive components. There are a range of suitable components to suit every development; and the applicant is encouraged to review the Ciria SuDS Manual C753.

3 Response 1

The policy and decision is duly noted. However, it should be recognised that during the pre-app consultation process the LPA requested that no incidental shared / open space in the form of visitors parking areas or green public open space should be provided within the scheme. This severely restricts the opportunity to provide green SuDS infrastructure.

4 Response 2

The Ground Investigation Report has stated that *'The information available from this ground investigation indicates that traditional soakaways are unlikely to be suitable for use on this site due to low permeability/infiltration rate of the cohesive deposits present and the presence of relatively high groundwater levels. The sand horizons present within the clays are irregular and discontinuous and consequently unlikely to provide sustainable infiltration*

properties. The viability and sustainability of traditional soakaways on this site will be limited.'

The ground investigation report is summarised to this document. Based on the findings of the ground investigation report, infiltration is not deemed viable.

Should BRE 365 testing be required, we would be happy to undertake testing and provide the results.

5 Response 3

Noted. Please see appended United Utilities asset records confirming that the surface water drainage discharges to Black Brook.

6 Response 4

As stated in the SuDS Manual, an alternative approach to managing the extra runoff volume from extreme events separately from the main drainage system is to release ALL runoff from the site at a maximum rate of either 2 l/s/ha OR Q_{bar} ; whichever is higher.

Given the constraints of the site, it is not practicable to provide additional long-term storage and therefore by restricting the site discharge to Q_{bar} , the development automatically complies with the runoff volume requirement.

This approach is a generally accepted industry standard in the UK.

7 Response 5

As advised under Response 1 above, during the pre-app consultation process the LPA requested that no incidental shared / open space should be provided within the scheme. This severely restricts the opportunity to provide significant green SuDS infrastructure as requested. The green SuDS included predominantly provides water quality benefits whilst slowing run off.

We have considered a number of available SuDS options in consultation with our client and detail these below with justification for provision/ non-provision.

Consideration of SuDS within the constraints of a dense urban environment	
Element	Viability
Green roofs rather than standard roof construction.	The majority of roofs to the houses are pitched and are therefore not suitable for green roofs. However, after further consideration we are proposing to introduce a green roof system on the areas of flat roof over proposed garages. Where possible, runoff from the pitched roof will be directed to these to further enhance water quality. Refer to Appendix C for summary of green roof areas. Any properties which are not provided with a garage will be drained by traditional means.
Runoff harvesting in tanks for non-potable use within buildings, such as toilet flushing.	The cost of implementing non-potable runoff harvesting within buildings on this scheme is not commercially viable.
Landscape irrigation and urban horticulture.	The cost of implementing harvesting for irrigation for the size of buildings and gardens within this scheme is not commercially viable.
Rainwater harvesting as a resource for water features and recreational play areas.	There are no shared spaces within the scheme.
Use of permeable surfaces and/or sub-bases.	The use of infiltration is not viable owing to the expected poor percolation of the clay ground conditions.
Use of bioretention systems, open water amenity features and tree pits.	Within the scope of the scheme there is no shared space for inclusion of open water amenity features e.g. attenuation ponds, detention basins etc. However, it is intended that a number of tree pits/ bio-retention areas can be introduced into the scheme which will intercept some run-off from the highway. It should be noted that this will be subject to agreement with the Local Highway Authority who will need to adopt and maintain these features in conjunction with the traditional drainage measures i.e. road gully's.
Inclusion of tree pits, landscaping planters, rain gardens, bioretention systems or swales provide storage and treatment of runoff.	The site levels make the use of swales challenging. Their space requirements would also result in the reduction to the number of proposed properties which would affect the commercial viability of the site. As indicated above, a number of bio-retention areas can be introduced into the adopted highway to intercept areas of proposed highway. Subject to agreement with the Local Highway Authority.

Front or back gardens to be designed as bioretention planters to capture roof runoff or configured to include rainwater harvesting systems.	As indicated above, rainwater harvesting systems are not considered to be viable for the development Green roofs are proposed to intercept roof runoff.
Flow control devices included to store water and/or provide treatment in confined spaces.	The scheme proposed does include for a flow control device to restrict run-off to the pre-development scenario. Given the constraints of the site, an offline storage tank is proposed in lieu of any surface level SuDS solutions.

Appendix A - GIR



Client:

Cringle Rd Developments Ltd
7 Leegate Close
Heaton Moor
Stockport
SK4 3NN

Ground Investigation - Geotechnical

Land off Cringle Road, Levenshulme, Manchester

Sept 2020

Site Ref: 6048/VCR-G v1.0

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Land off Cringle Road, Levenshulme, Manchester

Client:

Cringle Rd Developments Ltd
7 Leegate Close
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Client:

Cringle Rd Developments Ltd
7 Leegate Close
Heaton Moor
Stockport
SK4 3NN

Ground Investigation - Geotechnical

1. Introduction

This report is an account of an intrusive Geotechnical Ground Investigation carried out by GeoAssist Limited at the request of the Client, Cringle Rd Developments Ltd for the proposed Residential development on Land off Cringle Road, Levenshulme, Manchester.

The object of this geotechnical investigation was to obtain information on the nature, depth and extent of the superficial deposits beneath the site to assess ground conditions for a Residential development.

Geotechnical parameters and groundwater regime were to be obtained.

The work was commissioned following acceptance of the quotation and an instruction to proceed issued by the Client, Cringle Rd Developments Ltd on 5th August 2020.

The approximate grid reference for the centre of the site is 388410E, 393160N.

The exploratory hole locations are indicated on the site plan in Appendix A1 with the proposed development shown in Appendix A2.

2. Description of the Site

The site is located on Land off Cringle Road, Levenshulme, Manchester. The current access is off Nelstrop Road North. The site forms an irregular shape, the topography of which is generally flat and level with the surrounding area. The land is currently in use as stables and associated pasture.

At the time of the site visit, there were several small building structures and stables located to the southeast corner of the site. The rest of the site consists of heavily grazed paddocks divided by wooden fencing.

The site is bound by Highfield Country Park to the north and west, Cringle Road bounds part of the site to the south, followed by residential property. Nelstrop Road North borders the east of the site, over which lies further grazed paddocks.

3. Geology

The geological map of the area SJ 89 SE, resurveyed 1924-1932, shows the site to be located over Boulder Clay of the Recent and Pleistocene.

The underlying solid geology is shown as being Bunter Pebble Beds of the Permian and Triassic period.

No Faults are shown as passing directly beneath the site.

4. Mineworkings and Mineral Extraction

The property is in an area that may be affected by coal mining or mineral extraction.

The professional opinion of the Coal Authority report as issued for the phase I report summarises that:

‘According to the official mining information records held by the Coal Authority at the time of this search, evidence of, or the potential for, coal mining related features have been identified. It is unlikely that these features will impact on the stability of the enquiry boundary.’

The site is not situated within a Coal Authority High Risk area.

Consequently, the risk to the proposed development on this site in respect of past, present or future coal workings is classified as low.

5. Intrusive Investigation

5.1 Exploratory Hole Programme

A total of twenty one exploratory holes were undertaken by GeoAssist using windowless sampling and dynamic probing techniques over the proposed development site area. Exploratory holes BH1, BH2 and WS8 were undertaken utilising larger 100mm diameter windowless sampling equipment.

The locations of the exploratory holes are shown on the site plan in Appendix A1.

The details of the strata in the exploratory holes were recorded by a suitably qualified Professional Engineer.

All intrusive work was carried out generally in accordance with British standard 5930: 1999/2015 Code of Practice for Site Investigations and British Standard 10175: 2011 where relevant and applicable.

The fieldwork was completed between the 11th and 20th August 2020 in mainly dry weather conditions.

5.2 Field Sampling and Testing

Representative samples were taken of all the strata encountered in the exploratory holes.

All samples were stored in airtight containers and returned to the laboratory for subsequent examination and testing. Observations of groundwater conditions were made throughout the fieldwork operations.

Exploratory holes BH1, BH2, WS1 to WS5, WS8, WS10 and WS16 were converted to ground gas/groundwater monitoring standpipes upon completion. All other exploratory holes were backfilled and reinstated on completion.

5.3 Field Results

Full details of the subsoil conditions in the exploratory holes are given in the exploratory hole log sheets, which form Appendix C1 to this report.

6. Laboratory Investigation

6.1 Geotechnical Testing

The following geotechnical tests were performed in GeoAssist's laboratory on samples recovered from the exploratory holes.

Table 6.1 Geotechnical Testing

TEST	PURPOSE
Shear Strength from Hand Vane/Hand Penetrometer test	Assessment of in-situ shear strength of cohesive deposits
Natural Moisture Content and Classification test	Assessment of in-situ subsoil conditions and compressibility/shrinkage of cohesive deposits
Sulphate and pH test	Assessment of potential aggressive ground conditions with respect to subsurface concrete
Particle Size Distribution test	Determination of grading characteristics of granular deposits

6.2 Test Results

The results of the hand vane shear strength tests are given on the exploratory hole logs in Appendix C1.

The geotechnical test results are given in the laboratory test results summary sheets, which form Appendices D1 to D4 to this report.

7. Subsurface Stratigraphy

The subsoil profile obtained from the exploratory holes consists of Topsoil/Made Ground overlying gravelly sandy silty clays with sand inclusions overlying sandstone bedrock. The clays range firm at shallow depth becoming very stiff with depth.

Further details of the subsurface stratigraphy can be found in the exploratory hole log sheets which form Appendix C1 to this report.

Table 7.0 Subsoil Profile Summary

Strata	Depth of Strata (m) below ground level	
	Top	Base
Topsoil Generally clayey with roots	Ground Level	0.10 to 0.50 Absent in WS5 and WS17
Made Ground Variable mixed granular and cohesive	Ground Level	0.50 to 2.10 Absent in North East field
Upper Superficial Natural Deposits Soft sandy silty Clay with organic inclusions In WS4, WS5 and WS18	0.70 to 2.10 In WS4, WS5 and WS18	1.30 to 2.50 In WS4, WS5 and WS18
Superficial Natural Deposits Firm to very stiff gravelly sandy silty Clay with sand inclusions	0.10 to 2.20	8.00 to >10.00
Sandstone – Interpreted Stratum In BH1 and WS8	8.00 to 8.40 In BH1 and WS8	Not proven

8. Groundwater

Seepage groundwater was encountered in the exploratory holes during the course of the fieldwork ranging from 1.00m to 5.40m depth. A water level was noted in WS5 at 0.70m depth where evidence of an infilled pond was present. Elsewhere seepage groundwater was encountered with perched water in sand inclusions present within the less permeable clay subsoil. The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.

Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

Current water levels recorded in the monitoring standpipes indicate the presence of groundwater between 0.10m and 7.40m depth with generally localised high perched water levels between 0.40m and 1.60m depth across the site.

9. Geotechnical Properties

The following sections summarise the geotechnical properties for the upper strata, excluding the soft organic clays encountered in WS4, WS5 and WS18, on this site and are based on physical description, measured and empirical values.

9.1 Made Ground

Mixed sandy silty clay, sandy gravel with brick and concrete fragments was present across the site with WS5 indicating the presence of asbestos/cement fragments.

Table 9.1 Summary of Geotechnical Properties – mixed cohesive and granular

Property	Number of Tests	Range of Results	Derived Value
Sulphate 2:1 Water:Soil Extract	4	240 to 990 mg/l	990 mg/l
pH	4	7.2 to 8.2	NA

9.2 Sandy silty Clay

Gravelly sandy silty Clay was present across the site, generally of medium to high strength and low to intermediate plasticity with irregular high plasticity horizons.

Table 9.2 Summary of Geotechnical Properties – gravelly sand silty Clay with sand inclusions

Property	Number of Tests	Range of Results	Derived Value
Sulphate 2:1 Water:Soil Extract	5	180 to 420 mg/l	990 mg/l See above
pH	5	7.7 to 8.2	NA
Plasticity Index	8	14% to 31%	31%
Shear Strength From Hand Vane tests in firm to stiff clay within influencing depth of foundation	39	42 to 204kN/m ²	80kN/m ² For settlement <25mm

10. Geotechnical Assessment

10.1 Design Criteria

The following design criteria have been assumed as typical for the proposed development

1. Structural loads of up to 75kN/m on strip foundations at shallow depth of around 1.00m to 2.00m.
2. Total long-term settlements of less than 25mm and differential settlements less than 10mm.

10.2 Foundation Design Considerations

The following foundation design may be considered for this site.

Traditional strip footings located on the firm to stiff gravelly sandy silty clay generally present at shallow depth would generally be considered suitable for this site.

10.3 Shallow Depth Footings

Reinforced concrete foundations located on the silty clay can be designed to the bearing capacity given below with the likely associated settlements as indicated.

Depth m	Material	Foundation Type	Maximum Foundation Size m	Allowable bearing capacity kN/m ²	Long term Settlement mm
1.00 See Note	Firm to stiff gravelly sandy silty Clay (>2.00m deep at WS4 and WS5)	Strip	Up to 0.90 wide	120	<25

Note: the allowable bearing capacity is controlled by the medium to long term consolidation settlements that will occur in the low to high plasticity clays present on this site. The depth of foundations given above may have to be increased due to the heave/shrinkage potential of the clays present at formation level.

Concreting of foundations should take place as soon as formation level is exposed in order to prevent softening of the subsoil due to the potential ingress of surface/seepage groundwater.

Ground bearing slabs are considered to be unsuitable for use on this site due to the irregular presence of high plasticity clays, localised soft deposits and the potential for ground gas mitigation measures to require a vented zone beneath the foundation slabs.

10.4 Excavations

Ancillary shallow depth excavations (<1.50m) in the made ground/gravelly sandy silty clays will require nominal support with provision for the control of groundwater generally by pumping from open sumps.

10.5 Ground Shrinkage and Heave

The exploratory holes encountered cohesive deposits of low to high plasticity low to medium volume change potential. The NHBC Standards Section 4.2 Building near trees or similar for swell/shrinkage conditions should be followed for foundation design including any mitigating measures that might be required.

10.6 Soakaways

The information available from this ground investigation indicates that traditional soakaways are unlikely to be suitable for use on this site due to low permeability/infiltration rate of the cohesive deposits present and the

presence of relatively high groundwater levels. The sand horizons present within the clays are irregular and discontinuous and consequently unlikely to provide sustainable infiltration properties.

The viability and sustainability of traditional soakaways on this site will be limited.

10.7 Subsurface Concrete Attack

The results of the soluble sulphate and pH tests carried out on samples of subsoil obtained from this site in general indicate that according to Building Research Establishments Special Digest 1 (2005) no particular precautions for concrete foundations will be required.

Generally, the use of concrete mix design sulphate class DS-2 and according to ACEC Class AC-2 of Table C2 conditions can be used for subsurface concrete mix design.



Matthew Benson MSc GMICE
Geotechnical/Environmental Engineer



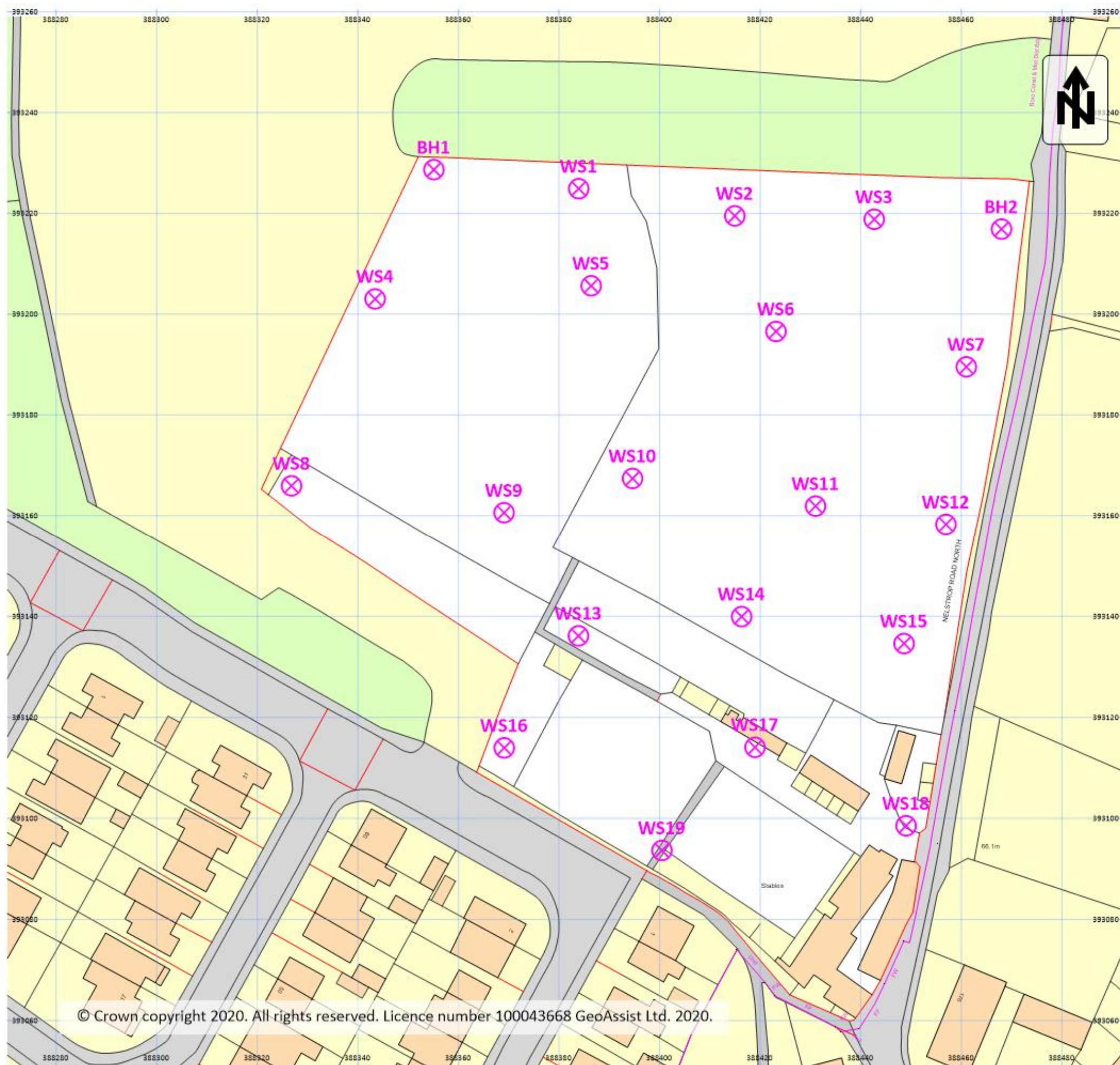
Mark Richardson MSc CEng MICE
Technical Director

Field investigations have been restricted to a level of detail required to achieve the stated objectives of the work. Ground conditions are, and can be, variable and have only been tested at isolated locations across the site. Therefore, the potential exists for ground conditions to be encountered which are different to those considered in this report.

This report has been prepared by GeoAssist Limited with all reasonable professional skill, care and diligence within the terms of the contract with Cringle Rd Developments Ltd. The report is confidential to Cringle Rd Developments Ltd, their /the named persons advisors and bankers, and GeoAssist Limited accepts no responsibility of whatever nature to third parties to whom this report may be divulged. GeoAssist Limited owns the copyright in this report. All rights are reserved, and unauthorised use is prohibited. Cringle Rd Developments Ltd may use the report for their/her/his own purposes.

Appendix A

- A1 Site Plan with Exploratory Hole Locations
- A2 Site Plan Proposed



A1. Plan

Site Name	Land off Cringle Road
Location	Levenshulme, Manchester
GeoAssist Ref	
Client	Cringle Rd Developments Ltd
	7 Leegate Close Heaton Moor Stockport SK4 3NN
Planning Consultant	
NGR (centre of site)	388410,393160
Production Date	August 2020
Survey Method	
Surveyor	Others
Status	Final v1.00
Base Survey	OSGB36



A2 Proposed Plan

Site Name	Land off Cringle Road
Location	Levenshulme, Manchester
GeoAssist Ref	
Client	Cringle Rd Developments Ltd
	7 Leegate Close Heaton Moor Stockport SK4 3NN
Planning Consultant	
NGR (centre of site)	388410,393160
Production Date	August 2020
Survey Method	
Surveyor	Others
Status	Final v1.00
Base Survey	OSGB36

Appendix B

- B1 Terminology used in Soil Descriptions
- B2 List of Abbreviations
- B3 Concrete in Aggressive Ground

Terminology used in Soil Descriptions

The procedure and principles given in BS EN ISO 14688-1:2002 Part 1: 'Identification and description' have been adopted in producing the soil descriptions contained within this report.

The general identification and description of soils is based on a flexible system for immediate (field) use by experienced persons, covering both material and mass characteristics by visual and manual techniques.

Details are given of the individual characteristics for identifying soils and the descriptive terms in regular use, including those related to the results of tests from the field.

This part of ISO 14688 is applicable to natural soils *in situ*, similar man-made materials *in situ* and soils redeposited by man.

Particular sections of BS EN ISO 14688-1:2002 Part 1 are reproduced here in order to clarify the production of the soil descriptions contained within this report.

Identification of soil

General

Soil characteristics that generally permit soil to be identified with adequate accuracy for general (or preliminary) characterization are outlined below. A more accurate identification and classification based on grading, plasticity or organic content can be achieved by laboratory tests. In addition to identifying soils, the condition in which a soil is encountered, any particular secondary constituents, other features of a soil, such as carbonate content, particle shape, surface roughness of particles, odour, any common names and the geological classification are indicated.

The identification and description of soils generally follows the flow chart in Figure B1.1 attached.

Particle size

Particle size is the fundamental basis for designating mineral soils using particle fractions to distinguish the soil mechanical behaviour.

Table B1 shows the terms to be used for each soil fraction and its sub-fractions, together with the corresponding chosen range of particle sizes.

Basic soils are soils with uniform grading (i.e. they consist of particles of only one size range as specified in Table B1.1

Table B1.1 Particle Size Fractions

Soil fractions	Sub-fractions	Symbols	Particle sizes mm
Very coarse soil	Large boulder	LBo	> 630
	Boulder	Bo	> 200 to 630
	Cobble	Co	> 63 to 200
Coarse soil	Gravel	Gr	> 2,0 to 63
	Coarse gravel	CGr	> 20 to 63
	Medium gravel	MGr	> 6,3 to 20
	Fine gravel	FGr	> 2,0 to 6,3
	Sand	Sa	> 0,063 to 2,0
	Coarse sand	CSa	> 0,63 to 2,0
	Medium sand	MSa	> 0,2 to 0,63
	Fine sand	FSa	> 0,063 to 0,2
Fine soil	Silt	Si	> 0,002 to 0,063
	Coarse silt	CSi	> 0,02 to 0,063
	Medium silt	MSi	> 0,006 3 to 0,02
	Fine silt	FSi	> 0,002 to 0,006 3
	Clay	Cl	≤ 0,002

APPENDIX B1

Form No.: QF029AEN

Composite soils

General

Most soils are composite and consist of principal and secondary fractions. They are designated by a noun (main term) describing the principal fraction and by one or more adjectives (qualifying terms) describing the secondary fractions (e.g. sandy gravel saGr, gravelly clay grCl).

Principal fraction

The principal fraction in terms of mass determines the engineering properties of the soil and is given in capital letters for clarity.

In the case of very coarse soils, the principal fraction is the relevant very coarse soil fraction predominating in terms of mass. The very coarse fraction should be separated from the sample before identifying the fine and coarse fractions.

In the case of coarse soils, the principal fraction is the relevant coarse soil fraction predominating in terms of mass.

Composite coarse soils include a fines fraction (silt and/or clay) that does not determine the engineering properties of the soil.

In the case of fine soils, the principal fraction is the relevant fine soil type determining the engineering properties of the soil.

In the case of composite fine soils, the fines fraction determines the engineering properties of the soil. The fines fraction is regarded as determining the characteristics of a composite soil if this is of at least medium dry strength or exhibits a certain degree of plasticity.

In both cases, the soil is termed either "clay" or "silt", depending on the plasticity of the fines fraction and not on the grading.

Secondary fractions

Secondary and further fractions do not determine but will affect the engineering properties of the soil. The secondary fractions as adjectives are placed with the term describing the principal fraction in the order of their relevance.

If coarse secondary fractions are present in a particularly small or particularly large proportion, the term "slightly" or "very" shall precede the qualifying term.

If it is a fine soil, the properties of which are determined by fines fractions, a soil can be identified as "silt" or "clay" by checking for the presence of fine secondary constituents on the basis of its plasticity properties.

If, in the case of coarse soils, two soil fractions are present in approximately equal proportions, an oblique shall be placed between the relevant terms, e.g. gravel/sand (Gr/Sa) or fine/medium sand (FSa/MSa).

Plasticity

Assessment of the plasticity and identification of a soil as either silt or clay permits the soil to be qualified as being of low plasticity or high plasticity.

An exact determination can only be made by establishing the liquid limit and the plastic limit in laboratory tests.

Organic content

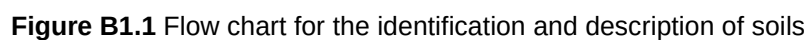
Small quantities of dispersed organic matter in a soil can produce a distinctive odour and colour. The intensity of odour and colour indicates the proportion of organic matter and should be described.

Determination of consistency

The consistency of a cohesive soil shall be determined in a manual test, permitting the following identification and description:

- a) a soil is to be identified as **very soft** if it exudes between the fingers when squeezed in the hand;
- b) a soil is to be identified as **soft** if it can be moulded by light finger pressure;
- c) a soil is to be identified as **firm** if it cannot be moulded by the fingers, but rolled in the hand to thick threads without breaking or crumbling;
- d) a soil is to be identified as **stiff** if it crumbles and breaks when rolled to thick threads but is still sufficiently moist to be moulded to a lump again;
- e) a soil is to be identified as **very stiff** if it has dried out and is mostly light coloured. It can no longer be moulded but crumbles under pressure. It can be indented by the thumbnail.

Preliminary descriptions are based on visual and manual identification only.



APPENDIX B1

Form No.: QF029AEN

Terminology used in Soil Classification

The procedure and principles given in BS EN ISO 14688-2:2004 Part 2: 'Principles for a classification' have been adopted in producing the soil descriptions contained within this report where laboratory or in situ field tests have been carried out.

The classification principles established in this part of ISO 14688 permit soils to be grouped into classes of similar composition and geotechnical properties and, with respect to their suitability for geotechnical engineering purposes.

This part of ISO 14688 is applicable to natural soil and similar man-made material *in situ* and redeposited, but it is not a classification of soil by itself.

Particular sections of BS EN ISO 14688-1:2002 Part 2 are reproduced here in order to clarify the production of the soil descriptions contained within this report.

Principles of soil classifications

General

Soils shall be classified into soil groups on the basis of their nature, which is the composition only, irrespective of their water content or compactness, taking into account the particle size distribution (grading), plasticity, organic content, genesis as appropriate.

The most common approach to classification is to divide the soils on the basis of particle size grading and plasticity. The division is made on the relative size fractions present for the coarser soil fractions, determined on the whole sample, and on the plasticity of the finer fractions (Table B1.2).

Table B1.2 Principles of a classification of soils

Criterion	Soil group	Quantification	Denomination into groups of similiar properties			Further subdivision as appropriate by
Wet soil does not stick together	very coarse	most particles > 200 mm	Bo	xBo		Requires special consideration
				boCo	coBo	
	most particles > 63 mm	Co	saCo, grCo	sagrCo		
	coarse	most particles > 2 mm	Gr	coGr	cosaGr	Particle size (grading) Shape of grading curve Relative density Permeability
			saGr, grSa	sasiGr, grsiSa		
		most particles > 0,063 mm	Sa	siGr, clGr orSa	siSa, clSa, saclGr	(Mineralogy) (Particle shape)
Wet soils sticks together	fine	low plasticity dilatant	Si	saSi	sagrSi saclSi	Plasticity Water content Strength, sensitivity Compressibility, stiffness (Clay mineralogy)
				clSi, siCl		
		plastic non-dilatant	Cl	orSi, orCl	sagrCl	
Dark colour, low density	organic		Or	saOr, siOr	clOr	Requires special consideration
Not naturally	Made ground	deposited	Mg	xMg	Man-made material	Requires special consideration
					Relaid natural materials	As for natural soils
Key to symbols						Cases requiring special consideration should be classified according to national or project requirements
Soil	Principal	Secondary or tertiary component				
Boulders	Bo	bo				
Cobbles	Co	co				
Gravel	Gr	gr	Gr(gr) and Sa(sa) can be subdivided into fine F(f), medium M(m) or coarse C(c)			
Sand	Sa	sa				
Silt	Si	si				
Clay	Cl	cl				
Organic	Or	or				
Made ground	Mg	—				
		x	any combination of components			

Appendix B1

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GeoAssist Limited

APPENDIX B1

Form No.: QF029AEN

Fractions

Soil is a mixture of materials of different particle size, which are grouped into fractions as specified in BS EN ISO 14688-1.

Classification of coarse and very coarse soils is to be based on the particle size distribution alone (see Table B1.3)

Table B1.3 Classification of very coarse soils

Fraction	Percent by mass	Term
Boulders	< 5	low boulder content
	5 to 20	medium boulder content
	> 20	high boulder content
Cobbles	< 10	low cobble content
	10 to 20	medium cobble content
	> 20	high cobble content

In the case of soils composed of both fine and coarse material, classification is to be based on both plasticity and particle size distribution.

Particle size distribution (grading)

The particle sizes and their distribution in a soil are determined by mechanical analysis carried out by the separation of the coarser fractions by sieving on a series of standard sieves and the determination of the finer fractions by sedimentation.

The results of the sieving and sedimentation process are plotted as a grading curve.

Plasticity

The fine fractions of soil, represented by clay and silt and containing clay minerals (see also BS EN ISO 14688-1), both alone or in mixtures with coarser material, are usually classified according to their plasticity characteristics. This is carried out on the basis of laboratory tests to determine the liquid limit w_L and plastic limit w_P .

Organic content

When soils with organic constituents are classified according to their organic content (Table B1.4), a distinction is to be made between organic soils and mineral soils with an organic content.

Table B1.4 Classification of soils with organic constituents

Soil	Organic content (≤ 2 mm) % of dry mass
Low-organic	2 to 6
Medium-organic	6 to 20
High-organic	> 20

Classification of coarse and composite organic soils accumulated *in situ* is based on the type of organic matter and that of organic soils, on the genetic origin and the degree of decomposition of the organic constituents.

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GeoAssist Limited

APPENDIX B1

Form No.: QF029AEN

Undrained shear strength of fine soils

The terms to be used for the designation of the undrained shear strength according to the results of laboratory and field tests are given in Table B1.5.

Table B1.5 Undrained shear strength of fine soils

Undrained shear strength of clays	Undrained shear strength c_u kPa
Extremely low	< 10
Very low	10 to 20
Low	20 to 40
Medium	40 to 75
High	75 to 150
Very high	150 to 300
Extremely high ^a	> 300
^a Materials with shear strength greater than 300 kPa may behave as weak rocks and should be described as rocks according to ISO 14689-1.	

Table B1.6 Guiding values for the division of mineral soils on a basis of the contents of various fractions

Fraction	Content of fraction in wt % of material ≤ 63 mm	Content of fraction in wt % of material ≤ 0,063 mm	Name of soil	
			Modifying term	Main term
Gravel	20 to 40 > 40		gravelly	gravel
Sand	20 to 40 > 40		sandy	sand
Silt + clay (fine soil)	5 to 15 15 to 40 > 40	< 20 ≥ 20 < 20 ≥ 20 < 10 10 to 20 20 to 40 > 40	slightly silty slightly clayey silty clayey clayey silty	 silt silt clay clay

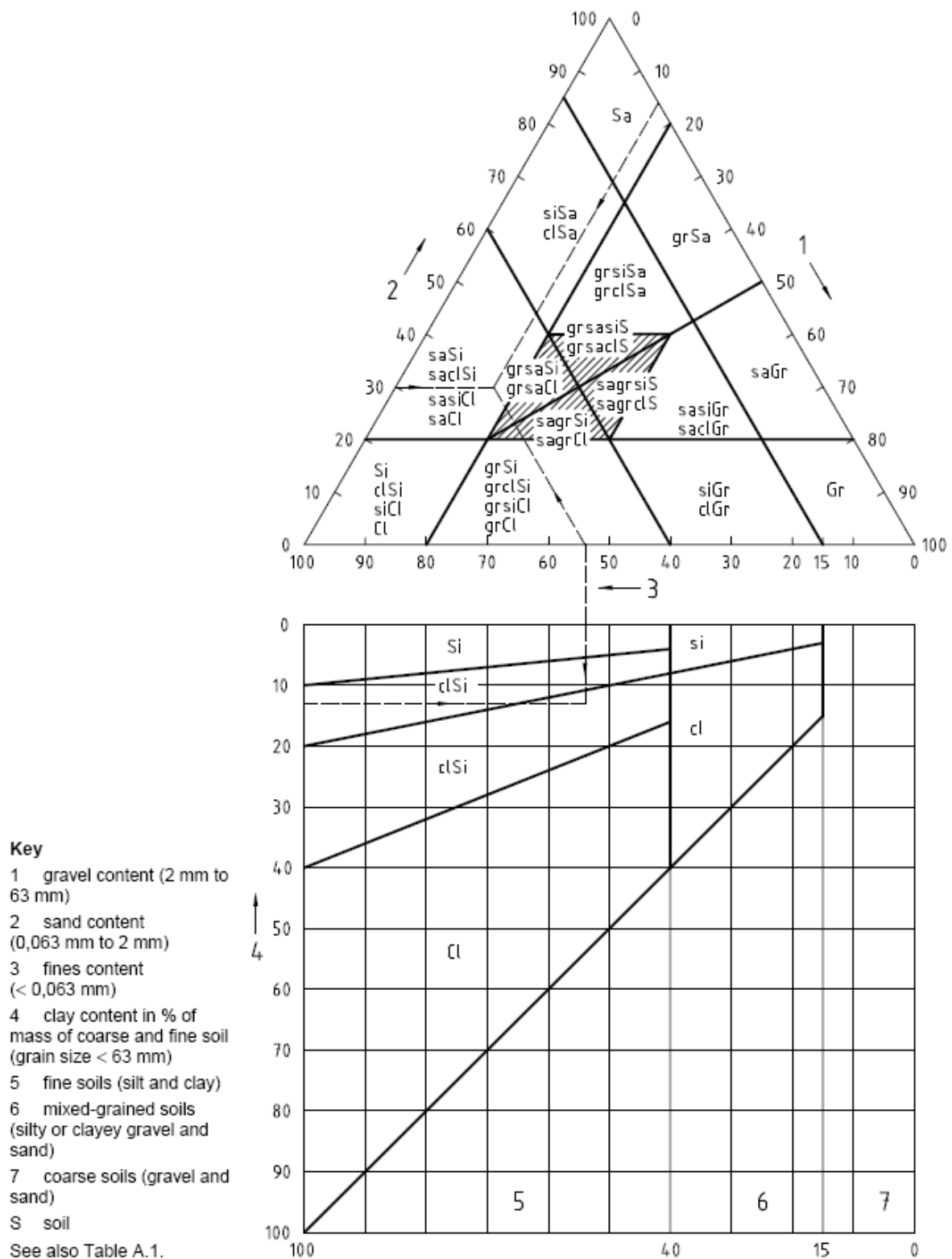


Figure B1.2 Classification of soils, based on grading alone

References

BS EN ISO 14688-1: 2002

Geotechnical investigation and testing — Identification and classification of soil — Part 1: Identification and description

BS EN ISO 14688-2: 2004

Geotechnical investigation and testing — Identification and classification of soil — Part 2: Principles for a classification

Abbreviations**Exploratory Hole log****Sample Type**

AGS Code	Sample Type	AGS Code	Sample Type
B	Bulk Disturbed sample	SPT	Penetration Test – split spoon
CBR	CBR sample	U	Undisturbed sample – open drive
CPT	Penetration Test – cone	UF	Undisturbed sample failed recovery
D	Small disturbed sample	W	Water sample
PU	Piston sample	C - ES	Environmental sample

SPT and CPT – Standard Penetration Test

Blow Count (N) – If full penetration of 450mm then the total number of blows for the last 300mm is given.

If limited penetration following 150mm seating blows then the number of blows for the stated penetration is given.

If limited penetration then the total number of blows for the stated penetration is given.

The N values are actual blows recorded and uncorrected.

U - Undisturbed Sample

Blow Count – total number of blows for recovered length

Legend – As per British Standard – if blank then CAVITY/OPEN HOLE

Core Rec.:

T - Total Core Recovery as a percentage of the cored run

S – Solid Core Recovery as a percentage of the cored run

RQD – Rock Quality Designation as a percentage of the cored run

FI – Fracture index as number of fractures per metre

l_f – Fracture spacing as the average length of solid core pieces between natural fractures over core length of reasonable uniform characteristics

APPENDIX B2

Form No.: QF033AEN

Laboratory Test Summary Sheet

Tests on Soils

AGS Code	Test Name	AGS Code	Test Name
ASB	Asbestos	IDEN	In Situ Density
BDEN	Bulk Density	IGNIS	Loss on Ignition
CBR	California Bearing Ratio	IVAN	In Situ Vane
CD	Consolidated drained (single stage)	LS	Linear shrinkage
CDM	Consolidated drained (multi stage)	MCVG	Moisture Condition Value
CLSS	Atterberg Limits	NMC	Natural Moisture content
CMPG	Compaction	OMS	Organic Matter
CNMT	Contaminant and Chemical	PD	Particle density
CONG	Consolidation	PHS	pH
CU	Consolidated undrained with pwp measurement (single stage)	PTST	Laboratory permeability
CUM	Consolidated undrained with pwp measurement (multi stage)	RELD	Relative Density
DDEN	Dry Density	SHBG	Shear box
FRST	Frost Susceptibility	SLIM	Shrinkage Limit
GRAD HY	Particle Size (Hydrometer)	SULWS	Sulphate on 2:1 Water:Soil Extract
GRAD WS	Particle size (wet Sieve)	TNPC	Ten Per Cent Fines
HVP	Hand vane – peak	UU	Unconsolidated quick undrained (single stage)
ICBR	In situ CBR	UUM	Unconsolidated quick undrained (multi stage)

Tests on rocks and Aggregates

AGS Code	Test Name	AGS Code	Test Name
ACV	Aggregate crushing value	SHOR	Shore hardness
BRAZ	Tensile Strength by Brazilian method	SOUN	Aggregate Soundness Test
LOSA	Aggregate Los Angeles Abrasion	UCS	Uniaxial Compressive Strength
PLSI	Point Load Index – size corrected	WTAB	Aggregate Water Absorption

4. Reference AGS Format Edition 3

Concrete in Aggressive Ground

1. Assessing the Aggressive Chemical Environment

In order to assess the levels of sulphate in the ground or groundwater, which may have a deleterious effect on concrete, the sulphate content of soil and groundwater may be determined in accordance with BS 1377 (2001) Test 3:5. The sulphate contents determined are grouped into Aggressive Chemical Environment for Concrete (ACEC) site classifications in Building Research Establishment Special Digest 1 – Part 1 (2005) Tables C1 and C2 as reproduced below.

Based on this classification BRE Special Digest 1 gives recommendations for the design of suitable concrete mixes to resist chemical attack for each ACEC classification. Care should be taken in the interpretation of results over the site area, if classification is based solely on groundwater analysis, it should be based on the highest sulphate concentration recorded. Where a large number of results from soil analysis are available it should be based on the average of the highest 20 per cent of the results. If a varied set of results are recorded from a limited sampling programme it is important to carry out further analyses before a detailed classification is given.

2. References

BS 1377: 2001: 'Methods of Test for Soils for Civil Engineering Purposes': British Standards Institution.

BRE Special Digest 1: 2005: 'Concrete in Aggressive Ground': Building Research Establishment.

Table C1 Aggressive Chemical Environment for Concrete (ACEC) classification for natural ground locations ^a						
Sulfate Design Sulfate Class for location	2:1 water/soil extract ^b	Groundwater	Total potential sulfate ^c	Groundwater Static water	Mobile water	ACEC Class for location
1	2 (SO ₄ mg/l)	3 (SO ₄ mg/l)	4 (SO ₄ %)	5 (pH)	6 (pH)	7
DS-1	< 500	< 400	< 0.24	≥ 2.5	> 5.5 ^d 2.5–5.5	AC-1s AC-1 ^e AC-2z
DS-2	500–1500	400–1400	0.24–0.6	> 3.5 2.5–3.5	> 5.5 2.5–5.5	AC-1s AC-2 AC-2s AC-3z
DS-3	1600–3000	1500–3000	0.7–1.2	> 3.5 2.5–3.5	> 5.5 2.5–5.5	AC-2s AC-3 AC-3s AC-4
DS-4	3100–6000	3100–6000	1.3–2.4	> 3.5 2.5–3.5	> 5.5 2.5–5.5	AC-3s AC-4 AC-4s AC-5
DS-5	> 6000	> 6000	> 2.4	> 3.5 2.5–3.5	≥ 2.5	AC-4s AC-5

Notes

- Applies to locations on sites that comprise either undisturbed ground that is in its natural state (ie is not brownfield – Table C2) or clean fill derived from such ground.
- The limits of Design Sulfate Classes based on 2:1 water/soil extracts have been lowered relative to previous Digests (Box C7).
- Applies only to locations where concrete will be exposed to sulfate ions (SO₄) which may result from the oxidation of sulfides (eg pyrite) following ground disturbance (Appendix A1 and Box C8).
- For flowing water that is potentially aggressive to concrete owing to high purity or an aggressive carbon dioxide level greater than 15 mg/l (Section C2.2.3), increase the ACEC Class to AC-2z.

Table C2 Aggressive Chemical Environment for Concrete (ACEC) classification for brownfield locations ^a								
Sulfate and magnesium						Groundwater		ACEC
Design Sulfate Class for location	2:1 water/soil extract ^b		Groundwater		Total potential sulfate ^c	Static water	Mobile water	Class for location
1	2	3	4	5	6	7	8	9
	(SO ₄ mg/l)	(Mg mg/l)	(SO ₄ mg/l)	(Mg mg/l)	(SO ₄ %)	(pH) ^d	(pH) ^d	
DS-1	< 500		< 400		< 0.24	≥ 2.5	> 6.5 ^e 5.5–6.5 4.5–5.5 2.5–4.5	AC-1s AC-1 AC-2z AC-3z AC-4z
DS-2	500–1500		400–1400		0.24–0.6	> 5.5 2.5–5.5	> 6.5 5.5–6.5 4.5–5.5 2.5–5.5	AC-1s AC-2 AC-2s AC-3z AC-4z AC-5z
DS-3	1600–3000		1500–3000		0.7–1.2	> 5.5 2.5–5.5	> 6.5 5.5–6.5 2.5–5.5	AC-2s AC-3 AC-3s AC-4 AC-5
DS-4	3100–6000	≤ 1200	3100–6000	≤ 1000	1.3–2.4	> 5.5 2.5–5.5	> 6.5 2.5–6.5	AC-3s AC-4 AC-4s AC-5
DS-4m	3100–6000	> 1200 ^e	3100–6000	> 1000 ^e	1.3–2.4	> 5.5 2.5–5.5	> 6.5 2.5–6.5	AC-3s AC-4m AC-4ms AC-5m
DS-5	> 6000	≤ 1200	> 6000	≤ 1000	> 2.4	> 5.5 2.5–5.5	> 2.5	AC-4s AC-5
DS-5m	> 6000	> 1200 ^e	> 6000	> 1000 ^e	> 2.4	> 5.5 2.5–5.5	≥ 2.5	AC-4ms AC-5m

Notes

- a Brownfield locations are those sites, or parts of sites, that might contain chemical residues produced by or associated with industrial production (Section C5.1.3).
- b The limits of Design Sulfate Classes based on 2:1 water/soil extracts have been lowered from previous Digests (Box C7).
- c Applies only to locations where concrete will be exposed to sulfate ions (SO₄²⁻), which may result from the oxidation of sulfides such as pyrite, following ground disturbance (Appendix A1 and Box C8).
- d An additional account is taken of hydrochloric and nitric acids by adjustment to sulfate content (Section C5.1.3).
- e The limit on water-soluble magnesium does not apply to brackish groundwater (chloride content between 12 000 mg/l and 17 000 mg/l). This allows 'm' to be omitted from the relevant ACEC classification. Seawater (chloride content about 18 000 mg/l) and stronger brines are not covered by this table.

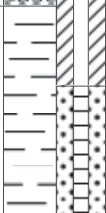
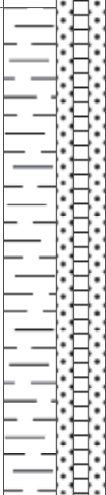
Appendix C

C1 Exploratory Hole Logs BH1, BH2 and WS1 to WS19

GeoAssist Limited		Exploratory Hole Record Sheet				Ref: BH1		
Consultant: 0		Project: Land off Cringle Road Location: Levenshulme, Manchester				Sheet: 1		
Client: Cringle Rd Developments Ltd		Equipment: Archway Dart Rig with 100mm diameter sampling				Ground Level: 64.65 m.AOD Co-ordinates: Easting: 388355.1(m) Northing: 393228.7(m) Dates: 13/08/2020 to 13/08/2020		
Drilling Foreman: M Walton STRATUM DESCRIPTION Engineer/Geologist: M Benson		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to		Blow Count N/(U)	Field Records
0 Dark grey clayey TOPSOIL with rootlets		(0.40) 0.40	64.25		0.30 0.40	C1		
1 Stiff to very stiff orange/brown with light grey gravelly sandy silty CLAY		(1.30)			0.50 0.60 0.60 0.70	C2 D1		Hand penetrometer at 0.60m - 110kPa
2 Brown silty fine to medium SAND		1.70	62.95					Hand penetrometer at 1.50m - 204kPa
3 Stiff to very stiff brown gravelly sandy silty CLAY		2.00	62.65					
4								
5								
6								
7								
8								
9								
10								
Light brown with orange/brown silty fine to medium SAND		7.60	57.05					Hand penetrometer at 2.50m - 195kPa
Orange/brown silty fine to medium SAND - weathered Sandstone		(0.40) 8.00	56.65					Hand penetrometer at 3.50m - 200kPa
Exploratory Hole terminated at 8.10m		8.10	56.55					Hand penetrometer at 4.50m - 144kPa
								Hand penetrometer at 5.50m - 125kPa
								Hand penetrometer at 6.50m - 217kPa
								Hand penetrometer at 7.50m - >250kPa
								13/08/2020: On completion of exploratory hole at 8.10m. Casing at 2.00m. Standing water level Nil. On withdrawal of casing gas/groundwater standpipe installed to 8.00m depth with response zone from 1.00m to 8.10m.
Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.		Logged: M Benson Date: 14/08/2020 Checked: M Richardson Date: 17/09/2020 Site Ref: 6048/VCR Scale 1:50						

GeoAssist Limited		Exploratory Hole Record Sheet				Ref: BH2		
Consultant: 0		Project: Land off Cringle Road Location: Levenshulme, Manchester				Sheet: 1		
Client: Cringle Rd Developments Ltd		Equipment: Archway Dart Rig with 100mm diameter sampling				Ground Level: 66.57 m.AOD Co-ordinates: Easting: 388468(m) Northing: 393216.9(m) Dates: 12/08/2020 to 12/08/2020		
Drilling Foreman: M Walton STRATUM DESCRIPTION Engineer/Geologist: M Benson		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to Sample Type/No		Blow Count N/(U)	
							Field Records	
0 Rough vegetation over brown sandy TOPSOIL with roots		0.30	66.27		0.30	0.40	C1	
Brown/grey very sandy silty CLAY		0.50	66.07		0.60	0.70	C2	
Stiff to very stiff orange/brown with light grey slightly gravelly sandy silty CLAY					0.90	1.00	D1	Hand penetrometer at 0.80m - 164kPa
(1.50)								Hand penetrometer at 1.50m - 92kPa
2 Stiff to very stiff brown/grey gravelly sandy silty CLAY		2.00	64.57		2.10	2.20	D2	Hand penetrometer at 2.10m - 207kPa
(8.00)								Hand penetrometer at 3.50m - 237kPa
								Hand penetrometer at 4.50m - 204kPa
								Hand penetrometer at 5.50m - >250kPa
								Hand penetrometer at 6.50m - 200kPa
								Hand penetrometer at 7.50m - 152kPa
								Hand penetrometer at 8.50m - 114kPa
								Hand penetrometer at 9.50m - 177kPa
Exploratory Hole complete at 10.00m		10.00	56.57					12/08/2020: On completion of exploratory hole at 10.00m. Casing at 3.00m. Standing water level Nil. On withdrawal of casing gas/groundwater standpipe installed to 10.00m depth with response zone from 1.00m to 10.00m.
Remarks:						Logged: M Benson		
The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.						Date: 14/08/2020		
Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.						Checked: M Richardson		
						Date: 17/09/2020		
						Site Ref: 6048/VCR		
						Scale 1:50		

GeoAssist Limited		Exploratory Hole Record Sheet				Ref: WS1	
Consultant: 0		Project: Land off Cringle Road Location: Levenshulme, Manchester				Sheet: 1	
Client: Cringle Rd Developments Ltd		Equipment: Archway Dart Rig				Ground Level: 64.94 m.AOD Co-ordinates: Easting: 388383.9(m) Northing: 393224.9(m) Dates: 13/08/2020 to 13/08/2020	
Drilling Foreman: M Walton STRATUM DESCRIPTION Engineer/Geologist: M Benson		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to		Field Records
					Sample Type/No	Blow Count N/(U)	
0 Grass over dark brown clayey TOPSOIL Dark brown very gravelly sandy clay - MADE GROUND		0.10 (0.50) 0.60	64.84 64.34		0.50 0.60	D1	
1 Stiff orange/brown with light grey gravelly sandy silty CLAY		(0.40) 1.00	63.94				Hand vane at 0.80m - 109kPa
1 Stiff brown with light grey gravelly sandy silty CLAY		(0.90)					Hand penetrometer at 1.50m - 125kPa
2 Brown silty fine to medium SAND		1.90	63.04				Wet at 1.90m depth
Brown sandy very silty CLAY		2.10	62.84				Hand penetrometer at 2.50m - >250kPa
Stiff to very stiff brown gravelly sandy silty CLAY		2.40	62.54				Hand penetrometer at 2.50m - >250kPa
3							Hand penetrometer at 3.50m - 114kPa
4		(3.60)					Hand penetrometer at 4.50m - 170kPa
5							Hand penetrometer at 5.50m - 179kPa
6 Exploratory Hole complete at 6.00m		6.00	58.94				13/08/2020: On completion of exploratory hole at 6.00m. Casing at 3.00m. Standing water level Nil. On withdrawal of casing gas/groundwater standpipe installed to 6.00m depth with response zone from 1.00m to 6.00m.
7							
8							
9							
10							
Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.						Logged: M Benson Date: 14/08/2020 Checked: M Richardson Date: 17/09/2020 Site Ref: 6048/VCR Scale 1:50	

GeoAssist Limited		Exploratory Hole Record Sheet				Ref: WS2			
Consultant: 0		Project: Land off Cringle Road Location: Levenshulme, Manchester				Sheet: 1			
Client: Cringle Rd Developments Ltd		Equipment: Archway Dart Rig				Ground Level: 65.22 m.AOD Co-ordinates: Easting: 388415(m) Northing: 393219.5(m) Dates: 11/08/2020 to 11/08/2020			
Drilling Foreman: M Walton STRATUM DESCRIPTION Engineer/Geologist: M Benson		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to		Sample Type/No	Blow Count N/(U)	Field Records
0 Grass over dark brown clayey sandy TOPSOIL with rootlets		(0.40) 0.40	64.82		0.30 0.40 0.50 0.60	C1 D1		Hand penetrometer at 0.60m - 87kPa	
1 Stiff orange/brown with light grey gravelly sandy silty CLAY		(1.60)						Hand penetrometer at 1.30m - 114kPa	
2 Very stiff brown gravelly sandy silty CLAY		2.00	63.22					Hand penetrometer at 2.50m - >250kPa Hand penetrometer at 3.50m - >250kPa Hand penetrometer at 4.50m - 212kPa Hand penetrometer at 5.50m - 145kPa	
3 Brown gravelly sandy silty CLAY with sand inclusions		5.70	59.52		5.70 6.15	P1	34	P1 at 5.70m - 9,10/8,7,10,9	
4 Exploratory Hole complete at 5.70m		(0.45) 6.15	59.07					11/08/2020: On completion of exploratory hole at 6.15m. Casing at 2.00m. Standing water level Nil. On withdrawal of casing gas/groundwater standpipe installed to 5.70m depth with response zone from 1.00m to 5.70m.	
5									
6									
7									
8									
9									
10									

Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.		Logged: M Benson Date: 17/08/2020 Checked: M Richardson Date: 17/09/2020 Site Ref: 6048/VCR Scale 1:50
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GeoAssist Limited		Exploratory Hole Record Sheet				Ref: WS3		
Consultant: 0		Project: Land off Cringle Road Location: Levenshulme, Manchester				Sheet: 1		
Client: Cringle Rd Developments Ltd		Equipment: Archway Dart Rig				Ground Level: 65.62 m.AOD Co-ordinates: Easting: 388442.7(m) Northing: 393218.8(m) Dates: 11/08/2020 to 11/08/2020		
Drilling Foreman: M Walton STRATUM DESCRIPTION Engineer/Geologist: M Benson		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to		Blow Count N/(U)	Field Records
0 Grass over dark brown sandy TOPSOIL		(0.40) 0.40	65.22					
Dark brown sandy silty clay with brick fragments - MADE GROUND Very stiff orange/brown with light grey gravelly sandy silty CLAY		0.50	65.12					
1		(0.80) 1.30	64.32					Hand penetrometer at 0.90m - 169kPa Hand penetrometer at 1.50m - 130kPa Hand penetrometer at 2.50m - 247kPa Hand penetrometer at 3.50m - 214kPa Hand penetrometer at 4.50m - 177kPa Hand penetrometer at 5.50m - 134kPa
2 Stiff to very stiff brown gravelly sandy silty CLAY with sand inclusions at depth		(4.70)						
3								
4								
5								
6 Exploratory Hole complete at 6.00m		6.00	59.62					11/08/2020: On completion of exploratory hole at 6.00m. Casing at 2.00m. Standing water level at 5.00m depth. On withdrawal of casing gas/groundwater standpipe installed to 5.30m depth with response zone from 1.00m to 5.30m.
7								
8								
9								
10								

Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.		Logged: M Benson Date: 21/08/2020 Checked: M Richardson Date: 17/09/2020 Site Ref: 6048/VCR Scale 1:50
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GeoAssist Limited		Exploratory Hole Record Sheet				Ref: WS4			
Consultant: 0		Project: Land off Cringle Road Location: Levenshulme, Manchester				Sheet: 1			
Client: Cringle Rd Developments Ltd		Equipment: Archway Dart Rig				Ground Level: 64.78 m.AOD Co-ordinates: Easting: 388343.4(m) Northing: 393203(m) Dates: 17/08/2020 to 17/08/2020			
Drilling Foreman: M Walton STRATUM DESCRIPTION Engineer/Geologist: M Benson		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to		Sample Type/No	Blow Count N/(U)	Field Records
0 Grass over dark brown sandy silty clay with rootlets - MADE GROUND		0.30	64.48		0.30	0.40	C1		
Brown/grey sandy silty clay with brick rubble, concrete and timber fragments - MADE GROUND					0.90	1.00	D1		
1 2		(1.80)							
2 Soft brown and dark grey very silty CLAY with organic inclusions		2.10	62.68						
Very stiff brown gravelly sandy silty CLAY		(0.40) 2.50	62.28		2.50	2.60	C2 D2		Hand vane at 2.30m - 23kPa Hand penetrometer at 2.60m - 194kPa
3 4 5 6		(3.50)			2.60	2.70			Hand penetrometer at 3.50m - >250kPa Hand penetrometer at 4.50m - >250kPa Hand penetrometer at 5.50m - 227kPa
6 Exploratory Hole complete at 6.00m		6.00	58.78						17/08/2020: On completion of exploratory hole at 6.00m. Casing at 3.00m. Standing water level Nil. On withdrawal of casing gas/groundwater standpipe installed to 6.00m depth with response zone from 1.00m to 6.00m.
7 8 9 10									
Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.								Logged: M Benson Date: 18/08/2020 Checked: M Richardson Date: 17/09/2020 Site Ref: 6048/VCR Scale 1:50	

Remarks:	Logged: M Benson Date: 17/08/2020 Checked: M Richardson Date: 17/09/2020 Site Ref: 6048/VCR Scale 1:50
The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.	

GeoAssist Limited		Exploratory Hole Record Sheet				Ref: WS6	
Consultant: 0		Project: Land off Cringle Road Location: Levenshulme, Manchester				Sheet: 1	
Client: Cringle Rd Developments Ltd		Equipment: Archway Dart Rig				Ground Level: 65.47 m.AOD Co-ordinates: Easting: 388423.1(m) Northing: 393196.6(m) Dates: 11/08/2020 to 11/08/2020	
Drilling Foreman: M Walton STRATUM DESCRIPTION Engineer/Geologist: M Benson		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to		Field Records
					Sample Type/No	Blow Count N/(U)	
0 Grass over dark brown clayey TOPSOIL with roots		0.30	65.17				
Firm orange/brown with grey slightly gravelly sandy silty CLAY		(1.10)					Hand vane at 0.90m - 65kPa
1		1.40	64.07				Hand vane at 1.30m - 70kPa
Brown with light grey silty fine to medium SAND with clay inclusions		(0.80)					
2		2.20	63.27				Hand penetrometer at 2.50m - 247kPa
Stiff to very stiff brown gravelly sandy silty CLAY with sand inclusions at depth		(3.80)					Hand penetrometer at 3.50m - 127kPa
3							Hand penetrometer at 4.50m - 152kPa
4							Hand vane at 5.50m - 78kPa
5							Wet at 5.60m depth
6		6.00	59.47				11/08/2020: On completion of exploratory hole at 6.00m. Casing at 3.00m. Standing water level Nil. On withdrawal of casing exploratory hole backfilled and reinstated.
Exploratory Hole complete at 6.00m							
7							
8							
9							
10							
Remarks:						Logged: M Benson Date: 21/08/2020 Checked: M Richardson Date: 17/09/2020 Site Ref: 6048/VCR Scale 1:50	
The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.							

GeoAssist Limited		Exploratory Hole Record Sheet				Ref: WS7	
Consultant: 0		Project: Land off Cringle Road Location: Levenshulme, Manchester				Sheet: 1	
Client: Cringle Rd Developments Ltd		Equipment: Archway Dart Rig				Ground Level: 65.96 m.AOD Co-ordinates: Easting: 388461(m) Northing: 393189.5(m) Dates: 12/08/2020 to 12/08/2020	
Drilling Foreman: M Walton STRATUM DESCRIPTION Engineer/Geologist: M Benson		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to		Field Records
					Sample Type/No	Blow Count N/(U)	
0 Grass over dark brown clayey TOPSOIL		0.10	65.86				
Firm orange/brown with light grey slightly gravelly sandy silty CLAY		(1.10)					Hand vane at 0.80m - 67kPa
1		1.20	64.76				Hand penetrometer at 1.50m - 112kPa
Stiff to very stiff brown with grey gravelly sandy silty CLAY		(1.80)					Hand penetrometer at 2.50m - >250kPa
2		3.00	62.96				Hand penetrometer at 3.50m - 192kPa
3 Very stiff brown gravelly sandy silty CLAY with sand inclusions at depth		(2.00)					Hand penetrometer at 4.50m - 247kPa
4		5.00	60.96				Hand penetrometer at 5.50m - 139kPa
5 Stiff brown sandy very silty CLAY with sand inclusions		(1.00)					Wet at 5.70m depth
6 Exploratory Hole complete at 6.00m		6.00	59.96				12/08/2020: On completion of exploratory hole at 6.00m. Casing at 3.00m. Standing water level at 5.40m depth. On withdrawal of casing exploratory hole backfilled and reinstated.
7							
8							
9							
10							
Remarks:						Logged: M Benson	
The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.						Date: 21/08/2020	
Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.						Checked: M Richardson	
						Date: 17/09/2020	
						Site Ref: 6048/VCR	
						Scale 1:50	

GeoAssist Limited		Exploratory Hole Record Sheet				Ref: WS8	
Consultant: 0		Project: Land off Cringle Road Location: Levenshulme, Manchester				Sheet: 1	
Client: Cringle Rd Developments Ltd		Equipment: Archway Dart Rig with 100mm diameter sampling				Ground Level: 65.01 m.AOD Co-ordinates: Easting: 388326.8(m) Northing: 393165.9(m) Dates: 19/08/2020 to 19/08/2020	
Drilling Foreman: M Walton STRATUM DESCRIPTION Engineer/Geologist: M Benson		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to Sample Type/No		Blow Count N/(U)
							Field Records
0 Grass over dark brown sandy TOPSOIL with roots		(0.40) 0.40	64.61				
Brown with orange silty sand, gravel and brick fragments with rootlets - MADE GROUND		(0.70)			0.50 0.60	C1	
1 Stiff orange/brown with light grey slightly gravelly sandy silty CLAY		1.10	63.91		1.00 1.10	D1	
					1.10 1.20	C2	
					1.20 1.30	D2	
2		(1.90)					Hand vane at 1.20m - 77kPa Hand penetrometer at 1.20m - 97kPa Hand penetrometer at 1.80m - 140kPa
							Hand penetrometer at 2.50m - 147kPa
3 Stiff to very stiff brown gravelly sandy silty to very silty CLAY		3.00	62.01				Hand penetrometer at 3.50m - 204kPa
							Hand penetrometer at 4.50m - 149kPa
4		(3.00)					Hand penetrometer at 5.80m - >250kPa
							Hand penetrometer at 6.50m - 175kPa
5							Hand penetrometer at 7.50m - 220kPa
6 Very stiff brown gravelly sandy silty CLAY		6.00	59.01				
7		(2.40)					
8		8.40	56.61				
9 Red/brown silty fine to medium SAND - weathered Sandstone		8.50	56.51		8.40 8.85	P1	P1 at 8.40m - (76 for 135mm) 19/08/2020: On completion of exploratory hole at 8.53m. Casing at 2.00m. Standing water level Nil. On withdrawal of casing gas/groundwater standpipe installed to 8.00m depth with response zone from 1.00m to 8.50m.
Exploratory Hole complete at 8.53m							
10							
Remarks:						Logged: M Benson Date: 20/08/2020 Checked: M Richardson Date: 17/09/2020 Site Ref: 6048/VCR Scale 1:50	
The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.							

Remarks:	Logged: M Benson
	Date: 19/08/2020
	Checked: M Richardson
	Date: 17/09/2020
	Site Ref: 6048/VCR
	Scale 1:50

GeoAssist Limited		Exploratory Hole Record Sheet				Ref: WS10	
Consultant: 0		Project: Land off Cringle Road Location: Levenshulme, Manchester				Sheet: 1	
Client: Cringle Rd Developments Ltd		Equipment: Archway Dart Rig				Ground Level: 65.07 m.AOD Co-ordinates: Easting: 388394.6(m) Northing: 393167.4(m) Dates: 17/08/2020 to 17/08/2020	
Drilling Foreman: M Walton STRATUM DESCRIPTION Engineer/Geologist: M Benson		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to		Field Records
					Sample Type/No	Blow Count N/(U)	
0 Grass over dark brown clayey TOPSOIL with roots		(0.40) 0.40	64.54				
1 Firm orange/brown with light grey slightly gravelly sandy silty CLAY with sand inclusions		(1.00) 1.40	63.54				Hand vane at 0.70m - 57kPa
2 Grey/brown silty fine to medium SAND with clay inclusions		(0.40) 1.80	63.14				Hand vane at 1.20m - 52kPa Wet at 1.40m depth
3 Firm brown gravelly sandy silty CLAY		2.00	62.94				Hand vane at 1.90m - 67kPa
4 Stiff to very stiff brown gravelly sandy silty to very silty CLAY		(4.00) 6.00	58.94				Hand penetrometer at 2.50m - >250kPa Hand penetrometer at 3.50m - >250kPa Hand penetrometer at 4.50m - >250kPa Hand penetrometer at 5.50m - 109kPa
5 Exploratory Hole complete at 6.00m							17/08/2020: On completion of exploratory hole at 6.00m. Casing at 2.00m. Standing water level at 5.80m depth. On withdrawal of casing gas/groundwater standpipe installed to 6.00m depth with response zone from 1.00m to 6.00m.
6							
7							
8							
9							
10							

Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.		Logged: M Benson Date: 21/08/2020 Checked: M Richardson Date: 17/09/2020 Site Ref: 6048/VCR Scale 1:50
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GeoAssist Limited Consultant: 0 Client: Cringle Rd Developments Ltd		Project: Land off Cringle Road Location: Levenshulme, Manchester Equipment: Archway Dart Rig				Ref: WS11 Sheet: 1	
Drilling Foreman: M Walton STRATUM DESCRIPTION Engineer/Geologist: M Benson		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to Sample Type/No Blow Count N/(U)		Field Records
0 Grass over dark brown clayey TOPSOIL		(0.40) 0.40	64.54				
-1 Firm to stiff orange/brown with light grey gravelly sandy silty CLAY		(1.60)					Hand vane at 0.70m - 67kPa Hand vane at 1.50m - 102kPa
-2 Very stiff brown with grey gravelly sandy silty to very silty CLAY with sand inclusions at depth		2.00	62.94				Hand penetrometer at 2.50m - 224kPa Hand penetrometer at 3.50m - >250kPa Hand penetrometer at 4.50m - 212kPa
-3							
-4		(4.00)					Hand penetrometer at 5.80m - >250kPa
-5							Wet at 5.40m depth
-6 Exploratory Hole complete at 6.00m		6.00	58.94				17/08/2020: On completion of exploratory hole at 6.00m. Casing at 2.00m. Standing water level at 4.70m depth. On withdrawal of casing exploratory hole backfilled and reinstated.
-7							
-8							
-9							
-10							

Remarks:

The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.

Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

Logged:

M Benson

Date:

21/08/2020

Checked:

M Richardson

Date:

17/09/2020

Site Ref:

6048/VCR

Scale 1:50

GeoAssist Limited		Exploratory Hole Record Sheet				Ref: WS12	
Consultant: 0		Project: Land off Cringle Road Location: Levenshulme, Manchester				Sheet: 1	
Client: Cringle Rd Developments Ltd		Equipment: Archway Dart Rig				Ground Level: 65.91 m.AOD Co-ordinates: Easting: 388456.9(m) Northing: 393158.3(m) Dates: 17/08/2020 to 17/08/2020	
Drilling Foreman: M Walton STRATUM DESCRIPTION Engineer/Geologist: M Benson		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to		Field Records
					Sample Type/No	Blow Count N/(U)	
0 Grass over dark brown/grey clayey TOPSOIL		0.30	64.64				
Brown and grey gravelly sandy silty CLAY		0.60	64.34		0.40 0.50	C1	
Grey silty SAND		0.80	64.14				
Firm to stiff orange/brown with light grey slightly gravelly sandy silty CLAY		1.00	63.94		0.90 1.00	D1	Hand vane at 0.90m - 58kPa Hand penetrometer at 0.90m - 65kPa
Very stiff orange/brown with light grey slightly gravelly sandy silty CLAY		(1.00)			1.20 1.30	D2	Hand penetrometer at 1.50m - 175kPa
2 Very stiff brown/grey gravelly sandy silty CLAY		2.00	62.94				Hand penetrometer at 2.50m - >250kPa
3		(1.90)					Hand penetrometer at 3.50m - 184kPa
4 Brown/grey silty to very silty fine to medium SAND		3.90	61.04				Hand penetrometer at 4.50m - >250kPa
Very stiff brown very silty CLAY		(0.50) 4.40	60.54				Hand penetrometer at 5.50m - 160kPa
5 Very stiff brown gravelly sandy silty CLAY		(0.90) 5.30	59.64				17/08/2020: On completion of exploratory hole at 6.00m. Casing at 2.00m. Standing water level Nil. On withdrawal of casing exploratory hole backfilled and reinstated.
6 Exploratory Hole complete at 6.00m		(0.70) 6.00	58.94				
7							
8							
9							
10							
Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.						Logged: M Benson Date: 18/08/2012 Checked: M Richardson Date: 17/09/2020 Site Ref: 6048/VCR Scale 1:50	

GeoAssist Limited		Exploratory Hole Record Sheet				Ref: WS13	
Consultant: 0		Project: Land off Cringle Road Location: Levenshulme, Manchester				Sheet: 1	
Client: Cringle Rd Developments Ltd		Equipment: Archway Dart Rig				Ground Level: 65 m.AOD Co-ordinates: Easting: 388383.9(m) Northing: 393136.1(m) Dates: 19/08/2020 to 19/08/2020	
Drilling Foreman: M Walton STRATUM DESCRIPTION Engineer/Geologist: M Benson		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to		Field Records
					Sample Type/No	Blow Count N/(U)	
0 Grass over dark brown with black clayey TOPSOIL		(0.50) 0.50	64.44				
Dark brown with black gravelly sandy silty clay with pottery and sandstone fragments - MADE GROUND		(0.50) 1.00	63.94				
1 Stiff to very stiff orange/brown with light grey gravelly sandy silty CLAY		(0.70) 1.70	63.24				Hand penetrometer at 1.50m - 155kPa
2 Very stiff brown gravelly sandy silty CLAY with sand inclusions at depth							Hand penetrometer at 2.50m - >250kPa
3		(3.30)					Hand penetrometer at 3.50m - 240kPa
4							Hand penetrometer at 4.50m - 247kPa
5 Very stiff brown gravelly sandy very silty CLAY		5.00	59.94				Hand penetrometer at 5.60m - 185kPa
6 Exploratory Hole complete at 6.00m		(1.00) 6.00	58.94				19/08/2020: On completion of exploratory hole at 6.00m. Casing at 2.00m. Standing water level Nil. On withdrawal of casing exploratory hole backfilled and reinstated.
7							
8							
9							
10							
Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.						Logged: M Benson Date: 21/08/2020 Checked: M Richardson Date: 17/09/2020 Site Ref: 6048/VCR Scale 1:50	

GeoAssist Limited		Exploratory Hole Record Sheet				Ref: WS14	
Consultant: 0		Project: Land off Cringle Road Location: Levenshulme, Manchester				Sheet: 1	
Client: Cringle Rd Developments Ltd		Equipment: Archway Dart Rig				Ground Level: 65.35 m.AOD Co-ordinates: Easting: 388416.3(m) Northing: 393139.9(m) Dates: 18/08/2020 to 18/08/2020	
Drilling Foreman: M Walton		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests		Field Records
Engineer/Geologist: M Benson					Depth (m) from to	Sample Type/No	
STRATUM DESCRIPTION							
0 Grass over dark brown clayey TOPSOIL with roots		(0.40) 0.40	64.54				
1 Firm orange/brown with light grey gravelly sandy silty CLAY		(1.60)					Hand vane at 0.70m - 44kPa Hand vane at 1.50m - 78kPa
2 Very stiff brown gravelly sandy silty CLAY		2.00	62.94				Hand penetrometer at 2.50m - 240kPa Hand penetrometer at 3.50m - >250kPa Hand penetrometer at 4.50m - 234kPa Hand penetrometer at 5.50m - 230kPa
3							
4		(4.00)					
5							
6 Exploratory Hole complete at 6.00m		6.00	58.94				18/08/2020: On completion of exploratory hole at 6.00m. Casing at 2.00m. Standing water level Nil. On withdrawal of casing exploratory hole backfilled and reinstated.
7							
8							
9							
10							
Remarks:						Logged: M Benson Date: 21/08/2020 Checked: M Richardson Date: 17/09/2020 Site Ref: 6048/VCR Scale 1:50	
The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.							

GeoAssist Limited		Exploratory Hole Record Sheet				Ref: WS15		
Consultant: 0		Project: Land off Cringle Road Location: Levenshulme, Manchester				Sheet: 1		
Client: Cringle Rd Developments Ltd		Equipment: Archway Dart Rig				Ground Level: 65.77 m.AOD Co-ordinates: Easting: 388448.6(m) Northing: 393134.6(m) Dates: 18/08/2020 to 18/08/2020		
Drilling Foreman: M Walton STRATUM DESCRIPTION Engineer/Geologist: M Benson		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to		Blow Count N/(U)	Field Records
0 Horse manure over dark brown organic very silty TOPSOIL		(0.40) 0.40	64.54					
1 Firm orange/brown with light grey gravelly sandy silty CLAY		(1.20)						Hand vane at 0.80m - 51kPa
1.60 Brown and grey silty fine to medium SAND		63.34						Hand vane at 1.50m - 63kPa Wet at 1.60m depth
2 Very stiff brown gravelly sandy silty to very silty CLAY		(0.40) 2.00	62.94					
3								Hand penetrometer at 2.50m - 194kPa
4		(4.00)						Hand penetrometer at 3.50m - >250kPa
5								Hand penetrometer at 4.50m - >250kPa
6 Exploratory Hole complete at 6.00m		6.00	58.94					Hand penetrometer at 5.50m - 170kPa 18/08/2020: On completion of exploratory hole at 6.00m. Casing at 3.00m. Standing water level Nil. On withdrawal of casing exploratory hole backfilled and reinstated.
7								
8								
9								
10								
Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.							Logged: M Benson Date: 21/08/2002 Checked: M Richardson Date: 17/09/2020 Site Ref: 6048/VCR Scale 1:50	

GeoAssist Limited		Exploratory Hole Record Sheet				Ref: WS16			
Consultant: 0		Project: Land off Cringle Road Location: Levenshulme, Manchester				Sheet: 1			
Client: Cringle Rd Developments Ltd		Equipment: Archway Dart Rig				Ground Level: 65.19 m.AOD Co-ordinates: Easting: 388369.1(m) Northing: 393114(m) Dates: 20/08/2020 to 20/08/2020			
Drilling Foreman: M Walton STRATUM DESCRIPTION Engineer/Geologist: M Benson		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to		Sample Type/No	Blow Count N/(U)	Field Records
0 Grass over dark brown clayey silty sandy TOPSOIL with roots		0.30	64.64						
Firm orange/brown with light grey slightly gravelly sandy silty CLAY		(1.00)			0.80	0.90	C1		
Orange/brown fine to medium SAND		1.30	63.64		1.20	1.30	D1		Hand vane at 1.20m - 61kPa Hand penetrometer at 1.20m - 65kPa
Firm to stiff grey/brown gravelly sandy silty CLAY		1.60	63.34						Hand vane at 1.70m - 74kPa
2 Brown very silty fine to medium SAND with clay inclusions		1.90	63.04		1.90	2.00	D2		Wet at 2.00m depth
Firm to stiff brown gravelly sandy silty CLAY		(0.50) 2.40	62.54						Hand vane at 2.50m - 67kPa Hand penetrometer at 2.50m - 100kPa
3 Stiff to very stiff brown gravelly sandy silty to very silty CLAY		(0.60) 3.00	61.94						Hand penetrometer at 3.50m - 142kPa
4 Very stiff brown/grey gravelly sandy silty CLAY		(2.00)							Hand penetrometer at 4.20m - >250kPa Hand penetrometer at 4.80m - >250kPa
5 Very stiff brown/grey gravelly sandy silty CLAY		5.00	59.94						Hand penetrometer at 5.50m - >250kPa
6 Exploratory Hole complete at 6.00m		(1.00) 6.00	58.94						20/08/2020: On completion of exploratory hole at 6.00m. Casing at 2.00m. Standing water level Nil. On withdrawal of casing gas/groundwater standpipe installed to 6.00m depth with response zone from 1.00m to 6.00m.
7									
8									
9									
10									

Remarks: 20/08/2020: Inspection pit excavated to 1.00m depth to avoid services. The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.		Logged: M Benson Date: 20/08/2020 Checked: M Richardson Date: 17/09/2020 Site Ref: 6048/VCR Scale 1:50	
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GeoAssist Limited		Exploratory Hole Record Sheet				Ref: WS17	
Consultant: 0		Project: Land off Cringle Road Location: Levenshulme, Manchester				Sheet: 1	
Client: Cringle Rd Developments Ltd		Equipment: Archway Dart Rig				Ground Level: 65.84 m.AOD Co-ordinates: Easting: 388419(m) Northing: 393114.1(m) Dates: 20/08/2020 to 20/08/2020	
Drilling Foreman: M Walton STRATUM DESCRIPTION Engineer/Geologist: M Benson		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to		Field Records
					Sample Type/No	Blow Count N/(U)	
0 Flagstone over grey sand, gravel and brick fragments - MADE GROUND		(0.40) 0.40	64.54				
Brown with light brown very silty SAND with gravel - POSSIBLE MADE GROUND		(0.70) 1.10	63.84				Wet at 1.00m depth
1 Firm to stiff brown with light grey gravelly sandy silty CLAY		(0.50) 1.60	63.34				Hand vane at 1.50m - 75kPa
2 Stiff to very stiff brown with grey gravelly sandy silty CLAY with sand inclusions		(1.40) 3.00	61.94				Hand penetrometer at 2.60m - 165kPa
3 Very stiff brown gravelly sandy silty CLAY		(1.00) 4.00	60.94				Hand penetrometer at 3.50m - 247kPa
4 Stiff brown with light brown very silty sandy CLAY with fine sand/silt inclusions		(1.20) 5.20	59.74				Hand vane at 4.50m - 93kPa
5 Very stiff brown gravelly sandy silty CLAY with sand inclusions at depth		(0.80) 6.00	58.94				Hand penetrometer at 5.50m - 222kPa
6 Exploratory Hole complete at 6.00m							20/08/2020: On completion of exploratory hole at 6.00m. Casing at 3.00m. Standing water level at 4.30m depth. On withdrawal of casing exploratory hole backfilled and reinstated.
7							
8							
9							
10							
Remarks: 20/08/2020: Inspection pit excavated to 1.00m depth to avoid services.						Logged: M Benson Date: 21/08/2020 Checked: M Richardson Date: 17/09/2020 Site Ref: 6048/VCR Scale 1:50	
The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.							

GeoAssist Limited		Exploratory Hole Record Sheet				Ref: WS18	
Consultant: 0		Project: Land off Cringle Road Location: Levenshulme, Manchester				Sheet: 1	
Client: Cringle Rd Developments Ltd		Equipment: Archway Dart Rig				Ground Level: 66.38 m.AOD Co-ordinates: Easting: 388449(m) Northing: 393098.5(m) Dates: 18/08/2020 to 18/08/2020	
Drilling Foreman: M Walton STRATUM DESCRIPTION Engineer/Geologist: M Benson		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to		Field Records
					Sample Type/No	Blow Count N/(U)	
0 Grass over thin TOPSOIL		0.10	64.84				
Brown/grey sandy gravel, brick and concrete fragments - MADE GROUND		(0.60) 0.70	64.24		0.40 0.50	C1	
Soft grey and dark grey organic silty CLAY		(0.60) 1.30	63.64				Hand vane at 0.80m - 26kPa
Grey/brown silty fine to medium SAND		1.60	63.34		1.60 1.70	C2	Wet at 1.30m depth
Stiff orange/brown with light grey gravelly sandy silty CLAY		1.90	63.04		1.70 1.80	D1	Hand penetrometer at 1.70m - 120kPa Wet at 1.90m depth
2 Brown/grey silty fine to medium SAND		2.20	62.74				
Stiff to very stiff brown with red/brown gravelly sandy silty CLAY		(1.60) 3.80	61.14				Hand penetrometer at 2.50m - 134kPa Hand penetrometer at 3.50m - 154kPa
4 Stiff brown very silty CLAY with silt/fine sand inclusions		(1.20) 5.00	59.94				Hand penetrometer at 4.40m - 200kPa
5 Stiff to very stiff brown gravelly sandy to very sandy silty CLAY with sand inclusions		(1.00) 6.00	58.94				Hand penetrometer at 5.50m - 150kPa
6 Exploratory Hole complete at 6.00m							18/08/2020: On completion of exploratory hole at 6.00m. Casing at 3.00m. Standing water level Nil. On withdrawal of casing exploratory hole backfilled and reinstated.
7							
8							
9							
10							

Remarks:		Logged: M Benson
The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.		Date: 19/08/2020
Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.		Checked: M Richardson
		Date: 17/09/2020
		Site Ref: 6048/VCR
		Scale 1:50

GeoAssist Limited		Exploratory Hole Record Sheet				Ref: WS19	
Consultant: 0		Project: Land off Cringle Road Location: Levenshulme, Manchester				Sheet: 1	
Client: Cringle Rd Developments Ltd		Equipment: Archway Dart Rig				Ground Level: 65.74 m.AOD Co-ordinates: Easting: 388400.5(m) Northing: 393093.7(m) Dates: 20/08/2020 to 20/08/2020	
Drilling Foreman: M Walton STRATUM DESCRIPTION Engineer/Geologist: M Benson		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests Depth (m) from to		Field Records
					Sample Type/No	Blow Count N/(U)	
0 Grass over dark brown clayey TOPSOIL with brick fragments and roots		(0.50) 0.50	64.44				
Dark brown/grey slightly gravelly sandy silty CLAY		0.80	64.14				Hand vane at 0.80m - 57kPa
1 Firm to stiff orange/brown with grey gravelly sandy silty CLAY		(1.20)					Hand penetrometer at 1.50m - 145kPa
		2.00	62.94				
2 Firm brown gravelly sandy silty to very silty CLAY with sand inclusions		(1.00)					Wet at 2.30m depth Hand vane at 2.60m - 67kPa
		3.00	61.94				
3 Brown/light brown silty fine to medium SAND		(0.50) 3.50	61.44				Hand penetrometer at 3.50m - 149kPa
Stiff brown gravelly very sandy silty CLAY		(0.50) 4.00	60.94				
4 Brown silty fine to medium SAND		(0.80)					Wet at 4.30m depth
		4.80	60.14				
Brown gravelly sandy very silty CLAY		5.00	59.94				20/08/2020: On completion of exploratory hole at 5.00m. Casing at 3.00m. Standing water level at 3.10m depth. On withdrawal of casing exploratory hole backfilled and reinstated.
5 Exploratory Hole complete at 5.00m							
6							
7							
8							
9							
10							
Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.						Logged: M Benson Date: 21/08/2020 Checked: M Richardson Date: 17/09/2020 Site Ref: 6048/VCR Scale 1:50	

Appendix D

D1	Laboratory Summary Sheet
D2	Classification Summary
D3	Sulphate and pH Summary
D4	Particle Size Analysis Graphs

GeoAssist Limited SOIL LABORATORY SUMMARY SHEET	Project: Land off Cringle Road Location: Levenshulme, Manchester Client: Cringle Rd Developments Ltd	Site Ref: 6048/VCR Project Code :
	Consultant :	Hole Ref BH1 and BH2 WS1 to W19

Sample Ref.	Depth m	Sample Description	Classification					Triaxial Compression					Chemical		Test Code
			LL %	PL %	PI %	% passing 425 m	Moist Cont. %	Bulk Density Mg/m ³	Sample Diameter mm	Lateral Pressure kN/m ²	Deviator Stress kN/m ²	Shear Cohesion kN/m ²	So4 2:1 extract Soil:Water mg/l	pH	
BH1 D1	0.60	Orange/brown with light grey gravelly sandy silty CLAY	44	18	26	98	20						190	8.0	NMC CLSS SULWS PHS
BH1 D2	2.50	Brown gravelly sandy silty CLAY	30	13	17	99	15								NMC CLSS
BH2 D1	0.90	Orange/brown with light grey slightly gravelly sandy silty CLAY	29	15	14	98	22						460	8.2	SULWS PHS
BH2 D2	2.10	Brown/grey gravelly sandy silty CLAY	34	14	20	98	14								NMC CLSS
WS1 D1	0.50	Dark brown gravelly sandy clay - MADE GROUND					-						360	8.2	SULWS PHS
WS2 D1	0.50	Orange/brown with light grey gravelly sandy silty CLAY	34	17	17	98	20								NMC CLSS
WS4 D1	0.90	Brown/grey sandy silty clay with brick rubble, concrete and timber fragments - MADE GROUND					-						520	7.8	SULWS PHS
BH4 D2	2.60	Brown gravelly sandy silty CLAY	29	14	15	97	14								NMC CLSS
WS5 D1	1.50	Dark grey and light grey sandy cinders and concrete fragments - MADE GROUND					-						990	7.2	SULWS PHS
WS5 D2	2.30	Brown gravelly sandy silty CLAY	28	13	15	97	15								NMC CLSS

GeoAssist Limited SOIL LABORATORY SUMMARY SHEET	Project: Land off Cringle Road Location: Levenshulme, Manchester Client: Cringle Rd Developments Ltd Consultant :	Site Ref: 6048/VCR Project Code :
		Hole Ref BH1 and BH2 WS1 to W19

Sample Ref.	Depth m	Sample Description	Classification					Triaxial Compression					Chemical		Test Code
			LL %	PL %	PI %	% passing 425 m	Moist Cont. %	Bulk Density Mg/m ³	Sample Diameter mm	Lateral Pressure kN/m ²	Deviator Stress kN/m ²	Shear Cohesion kN/m ²	So4 2:1 extract Soil:Water mg/l	pH	
WS8 D1	1.00	Brown with orange silty sand, gravel and brick fragments with rootlets - MADE GROUND					-						240	7.6	SULWS PHS
WS8 D2	1.20	Orange/brown with light grey slightly gravelly sandy silty CLAY	51	24	27	98	26								NMC CLSS
WS9 D1	0.90	Orange/brown with dark and light grey gravelly sandy silty CLAY					-						420	7.8	SULWS PHS
WS9 D2	1.10	Orange/brown with dark and light grey gravelly sandy silty CLAY	55	24	31	98	32								NMC CLSS
WS9 D3	1.80	Brown with grey silty to very silty fine to medium SAND					-								GRAD WS
WS12 D1	0.90	Orange/brown with light grey slightly gravelly sandy silty CLAY					-						350	7.7	SULWS PHS
WS12 D2	1.20	Orange/brown with light grey slightly gravelly sandy silty CLAY	33	16	17	98	17								SULWS
WS16 D1	1.20	Orange/brown with light grey slightly gravelly sandy silty CLAY	40	18	22	97	24								CLSS SULWS
WS16 D2	1.90	Brown very silty fine to medium SAND with clay inclusions					-								GRAD WS
WS18 D1	1.70	Orange/brown with light grey gravelly sandy silty CLAY	29	14	15	98	19						180	7.8	NMC CLSS SULWS PHS

Site Reference:			6048 VCR					
Project Site:			Land off Cringle Road					
Project Location:			Levenshulme, Manchester					
Client:			Cringle Rd Developments Ltd					
Consultant:			0					
CLASSIFICATION TEST								
Borehole Reference	Sample	Depth	Liquid Limit	Plastic Limit	Plasticity Index	% passing 425 micro	Natural Moisture Content	Material Code
BH1	D1	0.60	44	18	26	98	20	CI
BH1	D2	2.50	30	13	17	99	15	CL
BH2	D1	0.90	29	15	14	98	22	CL
BH2	D2	2.10	34	14	20	98	14	CL
WS2	D1	0.50	34	17	17	98	20	CL/CI
WS4	D2	2.60	29	14	15	97	14	CL
WS5	D2	2.30	28	13	15	97	15	CL
WS8	D2	1.20	51	24	27	98	26	CH
WS9	D2	1.10	55	24	31	98	32	CH
WS12	D2	1.20	33	16	17	98	17	CL
WS16	D1	1.20	40	18	22	97	24	CI
WS18	D1	1.70	29	14	15	98	19	CL
		Mean	36	17	20	98	20	
		Maximum	55	24	31	99	32	
CLAY		Minimum	28	13	14	97	14	
	Standard Deviation		9	4	6	1	5	
		Count	12	12	12	12	12	

Site Reference:			6048 VCR			
Project Site:			Land off Cringle Road			
Project Location:			Levenshulme, Manchester			
Client:			Cringle Rd Developments Ltd			
Consultant:			0			
GEOTECHNICAL SULPHATE AND PH TEST						
Borehole Reference	Sample	Depth	SO4 2:1 Water:Soil extract mg/l	pH	SO4 Water mg/l	
BH1	D1	0.60	190	8.0		
BH2	D1	0.90	460	8.2		
WS1	D1	0.50	360	8.2		
WS4	D1	0.90	520	7.8		
WS5	D1	1.50	990	7.2		
WS8	D1	1.00	240	7.6		
WS9	D1	0.90	420	7.8		
WS12	D1	0.90	350	7.7		
WS18	D1	1.70	180	7.8		

PARTICLE SIZE DISTRIBUTION GRAPH

Site Number: **6048**

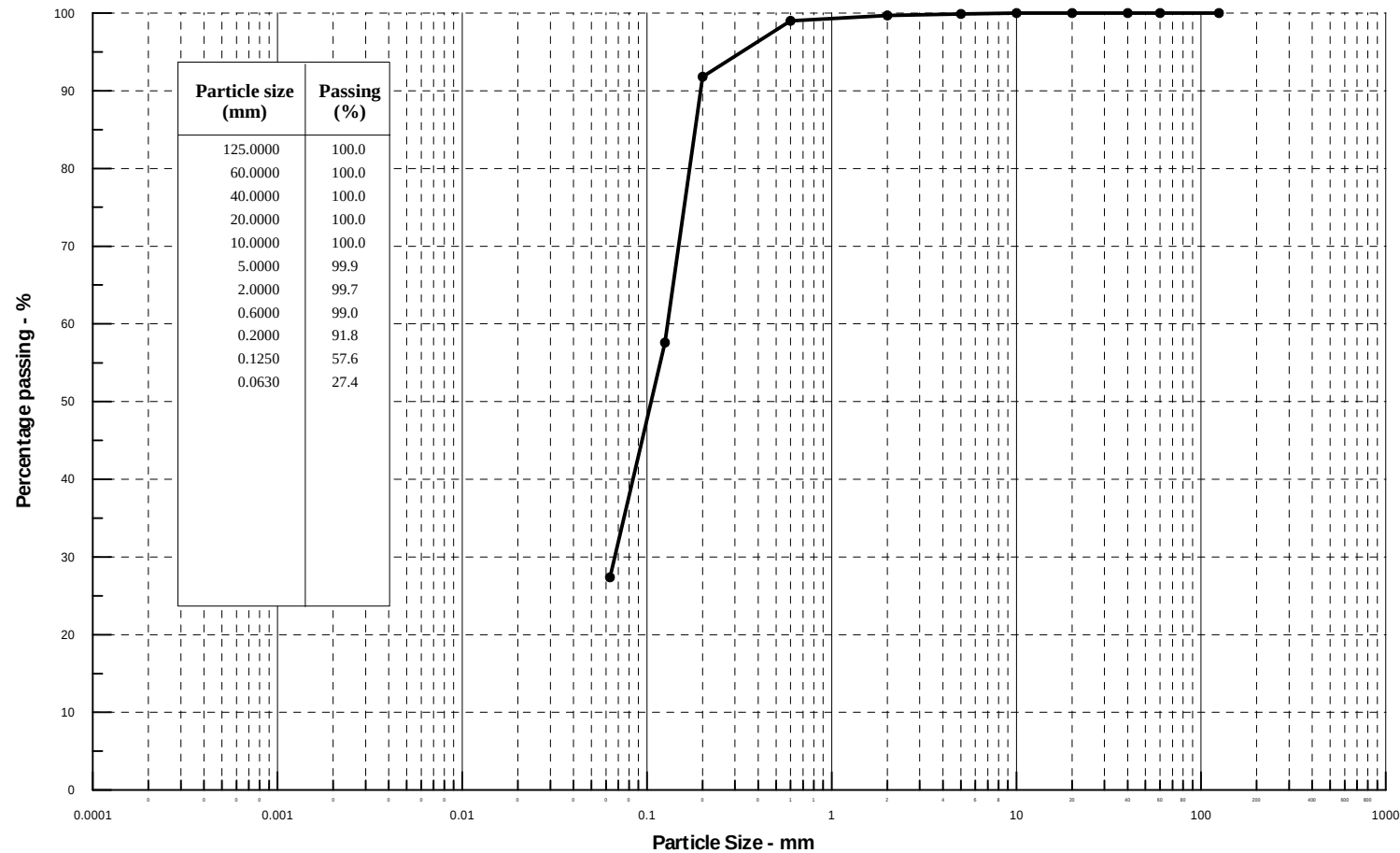
Site Reference: **VCR**

Project: **Land off Cringle Road**

Location: **Levenshulme, Manchester**

Client: **Cringle Rd Developments Ltd**

Consultant: **0**



BH No: WS9

Sample: D3

Depth: 1.80m

%	SIZE
0.0	Cobbles
0.3	Gravel
72.3	Sand
27.4	Silt and Clay

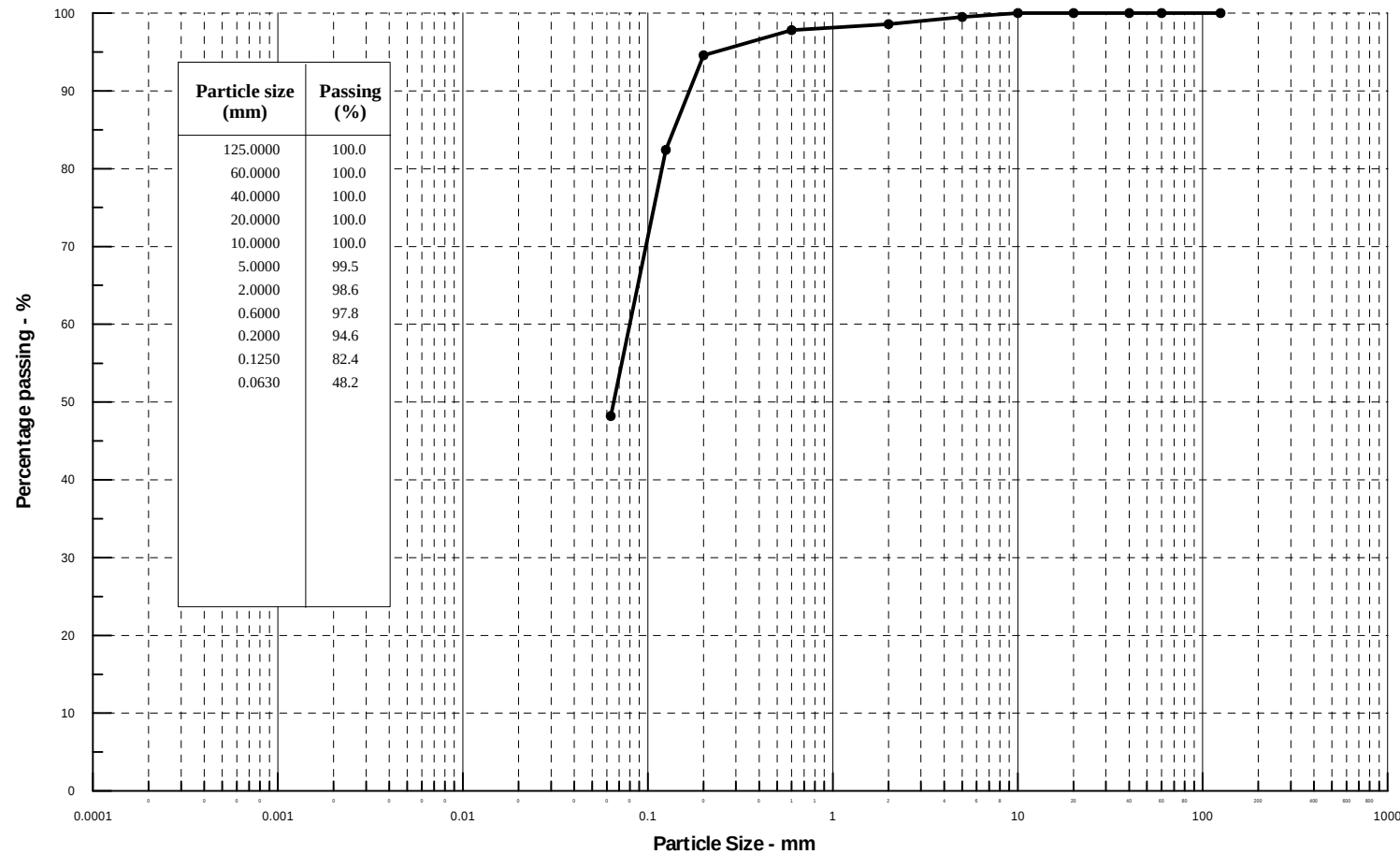
CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	GRAVEL	COB- BLES	BOUL DERS
	SILT			SAND					

PARTICLE SIZE DISTRIBUTION GRAPH

Site Number: **6048**

Site Reference: **VCR**

Project: **Land off Cringle Road**
 Location: **Levenshulme, Manchester**
 Client: **Cringle Rd Developments Ltd**
 Consultant: **0**



BH No: WS16

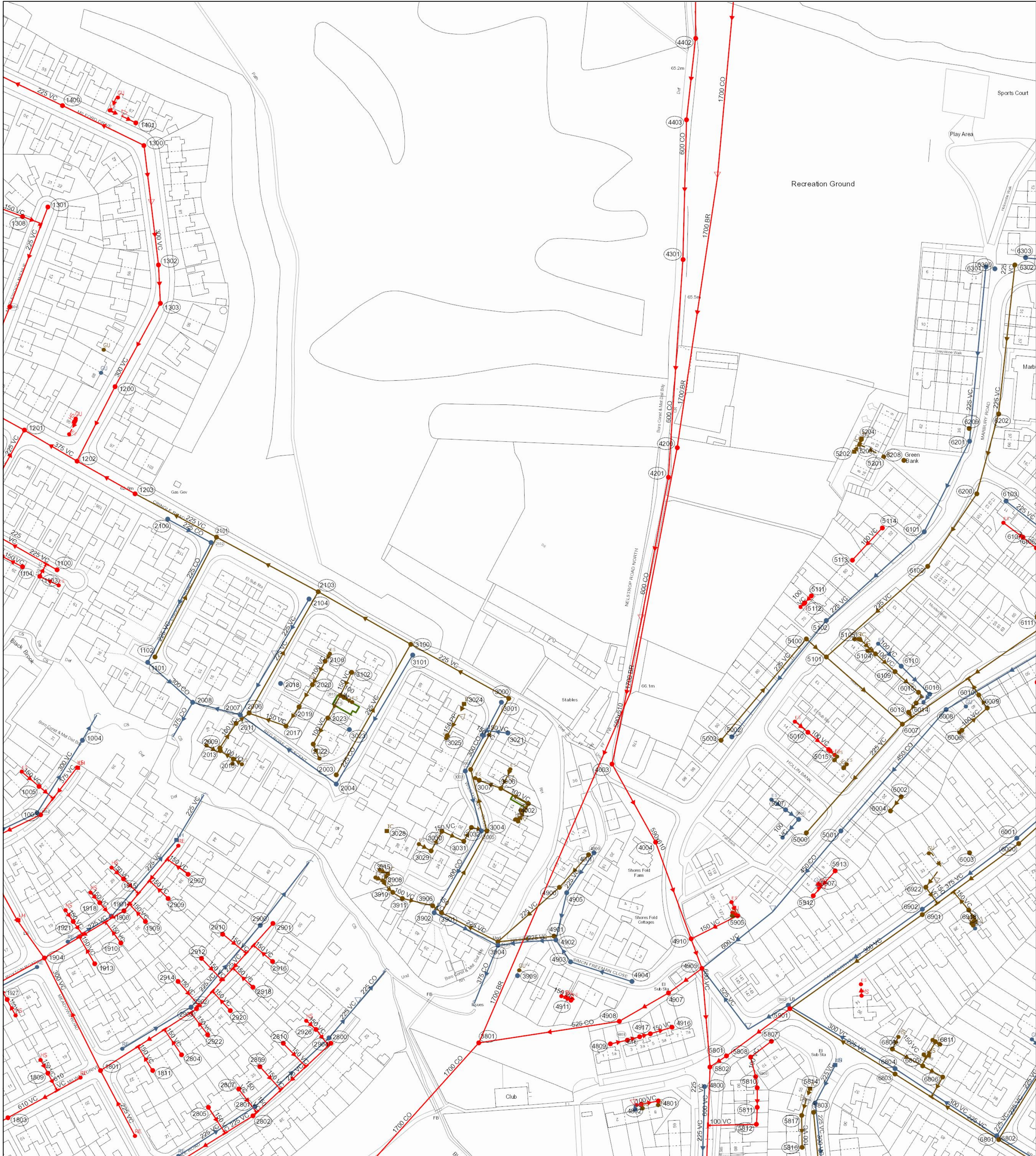
Sample: D2

Depth: 1.90m

%	SIZE
0.0	Cobbles
1.4	Gravel
50.4	Sand
48.2	Silt and Clay

CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	GRAVEL	COB- BLES	BOUL- DERS
	SILT			SAND					

Appendix B - UU Asset Records



Reho	Cover	Func	Invert	Size x	Size y	Shape	Matl	Length	Grad
6201	67.96	SW	65.47	225	VC	55.6017	VC	55.6017	1 in 24
5802	65.05	CO	63.19	600	VC	141.2693	VC	141.2693	1 in 24
6015		FO		100	VC	7.870824	VC	7.870824	
4003	66.16	FO	57.71	150	BR	49.2479	BR	49.2479	
6808		FO		150	VC	19.15431	VC	19.15431	
2801	64.76	SW	62.77	225	VC	55.5017	VC	55.5017	1 in 79
5101	67.29	FO	63.98	225	VC	55.97321	VC	55.97321	1 in 83
2904	63.96	SW	62.04	225	VC	24.78829	VC	24.78829	1 in 38
6303		SW	0	225	VC	61.29437	VC	61.29437	
6302	67.83	FO	65.46	225	VC	62.49242	VC	62.49242	
6202		FO		225	VC	46.60702	VC	46.60702	
2020		FO		100	VC	14.36158	VC	14.36158	
4802		CO		100	VC	9.597773	VC	9.597773	
6014		FO		100	VC	6.621807	VC	6.621807	
3007		FO		100	VC	2.318419	VC	2.318419	
2007	62.37	SW	59.3	300	CO	27.03885	CO	27.03885	1 in 129
1302	63.04	SW	59.61	300	VC	21.0208	VC	21.0208	1 in 131
2103	64.22	FO	59.85	225	VC	63.52052	VC	63.52052	1 in 159
1103		CO		150	VC	7.874804	VC	7.874804	
6006		FO		100	VC	18.59739	VC	18.59739	
6109		FO		100	VC	17.32414	VC	17.32414	
6918		FO		150	VC	13.11501	VC	13.11501	
1909		CO	0	150	VC	12.91722	VC	12.91722	
1201	62.33	CO	58.42	375	VC	33.12098	VC	33.12098	1 in 127
4800	65.01	SW	63.38	225	VC	68.0294	VC	68.0294	
3804	65.71	SW	64.11	225	VC	54.33231	VC	54.33231	1 in 151
4804	63.87	SW	62.51	225	VC	35.78514	VC	35.78514	1 in 74
6103	67.57	SW	0	225	VC	73.40981	VC	73.40981	
2022		CO		100	VC	8.54182	VC	8.54182	
1300	62.56	CO	60.31	225	VC	33.24154	VC	33.24154	1 in 88
2010		CO		100	VC	8.469398	VC	8.469398	
3002	65.14	FO	60.82	225	VC	44.29447	VC	44.29447	1 in 130
2104	64.14	FO	61.85	225	VC	37.21598	VC	37.21598	1 in 64
2106		FO		100	VC	11.14257	VC	11.14257	
3100	64.64	FO	60.22	225	VC	58.68956	VC	58.68956	1 in 163
1301	62.15	CO	60.3	225	VC	58.87275	VC	58.87275	1 in 97
2102	63.48	SW	61.45	225	CO	74.70609	CO	74.70609	1 in 66
3021		FO		150	VC	11.55687	VC	11.55687	
6200	67.71	FO	64.7	225	VC	48.59711	VC	48.59711	
4809		CO		600	VC	54.47087	VC	54.47087	
1203	63.07	CO	59.05	375	VC	36.71512	VC	36.71512	1 in 118
1102	61.81	FO	59.73	225	VC	74.42684	VC	74.42684	1 in 285
1304	62.1	CO	59.68	225	VC	56.0823	VC	56.0823	1 in 84
4402		CO		600	VC	45.27682	VC	45.27682	
2009		CO		100	VC	16.59989	VC	16.59989	
2100	63.29	SW	0	225	CO	27.29469	CO	27.29469	
1918		FO		150	VC	10.91623	VC	10.91623	
2003	62.8	FO	60.56	225	VC	82.85529	VC	82.85529	1 in 259
4200		FO		1700	BR	347.1747	BR	347.1747	
2013		FO		100	VC	1.532697	VC	1.532697	
5803	65.72	FO	63.79	300	VC	103.4877	VC	103.4877	1 in 211
3003	65.12	SW	62.78	300	VC	34.20536	VC	34.20536	1 in 122
6101	67.66	SW	0	225	VC	72.91776	VC	72.91776	
2008	62.07	SW	59.07	375	VC	21.65955	VC	21.65955	
3904	64.47	SW	61.62	375	CO	34.53983	CO	34.53983	1 in 60
2017		FO		150	VC	21.57988	VC	21.57988	
2914		CO	0	150	VC	17.78422	VC	17.78422	
4911		FO		150	VC	5.631601	VC	5.631601	
4301		CO		600	VC	120.2964	VC	120.2964	
5913		CO		150	VC	18.35069	VC	18.35069	
3101	64.73	CO	62.59	225	VC	82.40242	VC	82.40242	1 in 37
5902	65.25	SW	0	300	VC	25.72006	VC	25.72006	
4903	64.92	SW	62.34	225	VC	14.4222	VC	14.4222	
4917		CO		150	VC	12.51699	VC	12.51699	
4201		FO		600	VC	80.41145	VC	80.41145	
6803	65.93	FO	62.35	225	VC	68.29419	VC	68.29419	1 in 116
2900	63.47	SW	60.76	225	VC	44.20407	VC	44.20407	
6209		FO		100	VC	8.834448	VC	8.834448	
4901	65.38	FO	62.9	225	VC	31.14482	VC	31.14482	1 in 43
2902	64.03	SW	61.84	225	VC	58.99222	VC	58.99222	1 in 68
5010		CO		100	VC	14.87276	VC	14.87276	
6008	66.16	SW	0	450	VC	88.61716	VC	88.61716	
2011		FO		100	VC	8.198763	VC	8.198763	
5104		FO		100	VC	14.57512	VC	14.57512	
3902	63.32	SW	61.97	375	VC	39.39734	VC	39.39734	1 in 116
2015		FO		100	VC	14.48214	VC	14.48214	
4907		CO		100	VC	78.63334	VC	78.63334	
4403		CO		600	VC	77.92597	VC	77.92597	
3903	64.53	SW	62.16	225	VC	34.85553	VC	34.85553	1 in 47
3005	64.68	SW	62.48	300	VC	51.87115	VC	51.87115	1 in 106
2805		CO		150	VC	17.05161	VC	17.05161	
1303	63.2	CO		300	VC	62.35458	VC	62.35458	1 in 181
4909		CO		525	VC	22.84772	VC	22.84772	
4902	65.37	SW	62.02	225	VC	16.93102	VC	16.93102	1 in 115
6811		FO		150	VC	15.23617	VC	15.23617	
2102	63.53	FO	59.44	225	VC	51	VC	51	1 in 178
5901	65.29	CO	61.82	300	VC	43.60048	VC	43.60048	
5905		FO		150	VC	28.69148	VC	28.69148	
3001	65.24	SW	63.05	300	VC	42.84165	VC	42.84165	1 in 172
3000	65.24	FO	60.48	225	VC	61.73738	VC	61.73738	1 in 247
6002		FO		150	VC	8.892505	VC	8.892505	
4908		CO		525	VC	78.24241	VC	78.24241	
4004		CO		600	VC	17.3376	VC	17.3376	
6100		FO		225	VC	75.0733	VC	75.0733	
1101	61.76	SW	59.39	300	VC	33.23699	VC	33.23699	1 in 107
4001	65.95	SW	64.45	225	VC	26.62705	VC	26.62705	1 in 40
3910		FO		225	VC	23.41379	VC	23.41379	
6801	66.36	FO	63.1	225	VC	67.41662	VC	67.41662	1 in 94
1400	62.21	CO	59.54	225	VC	55.4617	VC	55.4617	1 in 88
5801	65.12	CO		300	VC	10.61665	VC	10.61665	
2019		FO		100	VC	12.69248	VC	12.69248	
1004		FO		300	VC	16.12452	VC	16.12452	
5003	66.78	FO	64.67	225	VC	73.1095	VC	73.1095	
5006		SW		100	VC	13.30223	VC	13.30223	
6805		FO		150	VC	12.69222	VC	12.69222	
3006		FO		100	VC	12.75033	VC	12.75033	
3008	63.53	FO	61.61	150	VC	6.24418	VC	6.24418	1 in 104
3018		UN		100	VC	2.152776	VC	2.152776	
5001		CO		450	VC	59.26514	VC	59.26514	
6013		FO		100	VC	3.416851	VC	3.416851	
6802	66.35	SW	0	300	VC	67.11629	VC	67.11629	
1005		FO		150	VC	10.26247	VC	10.26247	
1200	62.96	CO	59.14	300	VC	46.06517	VC	46.06517	1 in 125
4006	66.87	FO	64.08	225	VC	24.98319	VC	24.98319	1 in 29
2004	62.74	SW	60.25	225	VC	65.23438	VC	65.23438	1 in 69
4009		FO		150	VC	9.5462	VC	9.5462	
1002	61.55	SW	0	300	VC	47.16991	VC	47.16991	
6010		FO		100	VC	10.91632	VC	10.91632	
6902	65.96	SW	0	375	VC	91.82197	VC	91.82197	
6804	65.9	SW	63.09	300	VC	68.50029	VC	68.50029	
4907		CO		525	VC	31.37978	VC	31.37978	
2023		FO		100	VC	16.46059	VC	16.46059	
4905	65.41	CO	63.77	225	VC	26.65333	VC	26.65333	1 in 148
6301		SW	0	225	VC	96.42095	VC	96.42095	
6007	66.1	FO	63.19	225	VC	80.95623	VC	80.95623	
4002		FO		100	VC	17.27533	VC	17.27533	
6901	65.95	FO	62.49	300	VC	89.2701	VC	89.2701	1 in 103
4800	65.68	FO	63.2	225	VC	45.34314	VC	45.34314	1 in 45
4809		FO		150	VC	7.041515	VC	7.041515	
5015		CO		100	VC	4.687787	VC	4.687787	
4918		FO		150	VC	6.149882	VC	6.149882	
3004	64.69	FO	61.93	225	VC	35.17101	VC	35.17101	1 in 178
5817		FO		100	VC	17.59005	VC	17.59005	
6806		FO		150	VC	12.59962	VC	12.59962	
5100	67.19	FO	0	225	VC	14.86607	VC	14.86607	
1913		CO		150	VC	16.96955	VC	16.96955	
3801		CO		1700	VC	196.7213	VC	196.7213	
1927		CO		150	VC	10.15165	VC	10.15165	
1308		FO		150	VC	11.5903	VC	11.5903	
4004		CO		600	VC	55.78092	VC	55.78092	
5007		SW		100	VC	8.825373	VC	8.825373	
3901	63.45	FO	61.41	225	VC	51.47815	VC	51.47815	1 in 143
3025		FO		150	PP	1.353132	PP	1.353132	
6110									

Appendix C - Green Roof Areas

House Type	No.	Total roof area (per site) (m ²)	Green roof area (per site) (m ²)	% of pitched roof area drainage to green roof	Sub-total roof area (m ²)	Sub-total green roof area (m ²)	% of green roof
A and B	30	104.75	17.2	50%	3142.5	1829.25	58%
C	24	59	0	0%	1416	0	0%
D	3	60	0	0%	180	0	0%
Total					4738.5	1829.25	39%